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GRASSING EXPERIMENTS ON HILL COUNTRY IN WHANGAMOMONA COUNTY.

(Continued from October.)

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2. The Secondary Burn.

IN the country under review failure of the primary-burn pasture sowings means secondary growth in one form or another. According to the measures adopted, and on the varying success in forming a pasture sward, depends the nature of the secondary growth that puts in an appearance.* Possible methods of dealing with these classes of growth were outlined in the *Journal* for June, 1927, and after four years' additional study I am more firmly convinced that the fire-stick and the seed-bag should supersede crushing by stock. Manurial top-dressing after seeding, wherever practicable, makes the work of subsequent control by stock surer and easier, and to this end also fences are imperative.

THE GRASS-SEED MIXTURE.

The outstanding feature of the regrassing work in the Whangamomona country is the unqualified success, after eight years' trial, of brown-top (*Agrostis tenuis*), Lotus major, and Danthonia pilosa. Over eighty species of grasses and clovers have been tried there, but the final seed mixture might well consist of three—brown-top, Lotus major, and Danthonia pilosa. As in the case of the primary burn, however, there is an initial phase of relatively high fertility due to the ash, and it is sound to include in the seed mixture some species that will establish rapidly and produce during that comparatively long establishment period of brown-top, Lotus major, and Danthonia pilosa. Perennial rye-grass, crested dogstail, and white clover are the best species to use for this purpose. Also, if top-dressing is possible, and for those better slopes, hollows, and places where stock camp, it will be found, provided good perennial strains are used, that these high-production species more

* See this *Journal* for September, 1923, for order of development of secondary scrub and secondary-forest associations.

FIG. 1. BROWN-TOP, LOTUS MAJOR, DANTHONIA PILOSA SWARD ON ONE OF THE EXPERIMENTAL SOWINGS.
These three species are fundamental to the regrassing of secondary-growth country of the Whangamomona type. Crested dogstail, white clover, and rye-grass are also important for the early phase, and for the easier and better aspects, or where top-dressing is practicable. (Compare Fig. 10.)
[Photo by E. Bruce Levy.

than hold their own with brown-top, Lotus major, and Danthonia pilosa. Again, particularly in dealing with bracken-fern burns, early establishment gives earlier control by stock in virtue of the greater amount of feed produced.

The following seed mixture is recommended, as the outcome of eight years' trial, for all manner of secondary-growth burns of the Whangamomona type of country :—

	lb.
Perennial rye-grass	8
Crested dogstail	4
Brown-top	2
Danthonia pilosa	3
White clover	1
Lotus major	1
Total per acre	19

In logging up burns or secondary burns where much timber is burnt 4 lb. of cocksfoot may be added to advantage. On some of the harder country 3 lb. of Chewings fescue and ¼ lb. of yarrow may be added, and the rye-grass and crested dogstail somewhat reduced.

I would again, however, like to emphasize the necessity of brown-top, Lotus major, and Danthonia pilosa. Where it is necessary to sacrifice some efficiency in regard to the seed mixture on account of cost, on no consideration should the brown-top, Lotus major, and Danthonia pilosa be stinted. Seconds of rye-grass, containing some white clover and suckling clover, may be used as a filler in order to spread the brown-top, Lotus major, and Danthonia pilosa, and it is along these lines that the sacrifice should be made. Crested dogstail is not absolutely essential, but it will be missed during the first three years at least, and for a much longer period if top-dressing at a later date is practicable. It must be remembered that control of the secondary growth to follow is largely dependent on the sward secured, and that the better the sward the easier the control.

Strain in Relation to Primary and Secondary Burn Seed-mixtures.

As in the case of all permanent-pasture seed-mixtures, strain in those for surface-sowing needs close attention. In both primary and secondary burns the failure of any one species through using wrong types, or the wrong seed, may have a permanent detrimental effect on the area being sown. The following notes, giving the strain or origin recommended as an outcome of experimental sowings in each species, should be carefully applied :—

Perennial rye-grass : Use certified New Zealand perennial rye-grass. The false perennial types are no better than Italian rye-grass.

Cocksfoot : Any cocksfoot of New Zealand origin. Imported Danish has 1 per cent. of seeds stained red.

Crested dogstail : Any New Zealand or imported seed. No superior type of crested dogstail on a commercial basis has yet been located.

Brown-top : Southland, Otago, Canterbury foothills, Wairarapa, and Waipu are all good types. The dry-land type harvested on the light arable Canterbury plains should not be used for these hill-country sowings.

FIG. 2. ONE OF THE EXPERIMENTAL AREAS IN 1924, BEFORE WORK COMMENCED.

FIG. 3. THE SAME AREA AS IN FIG. 2 IN 1930.

The area is here virtually free of secondary growth and is well grassed. Top-dressed three times since 1924 and sprayed once with arsenic pentoxide.

[*Photos by E. Bruce Levy.*

Danthonia pilosa: Best results have been secured from Canterbury seed, largely owing to superior germination compared with Hawke's Bay and Auckland seed.

White clover: Certified New Zealand white clover, when this becomes more easy to secure, should give best results, but trials at Whangamomona of this type have not been down sufficiently long for

forming a definite opinion. Failing certified white clover, use ordinary New Zealand white, but avoid any imported white clover except Kentish wild white. The price of the latter, however, is prohibitive.

Lotus major: Southland Lotus major is the best, although unfortunately only small supplies are available. Imported Lotus major is quite satisfactory. Auckland-grown Lotus major needs careful buying because of high impurity content, particularly of Lotus hispidus, which has proved quite useless as a substitute for Lotus major.

No seed mixture, however, that could possibly be devised in itself will control secondary growth. The predisposition of the class of country under review to run to forest is too strong, and these secondary growth associations must be recognized as stepping-stones back to forest. Natural grassland associations are possible without man's assistance only where scrub-land or forest is impossible owing to climate. The act of felling and burning the forest does not alter one whit the urge of the country to afforest itself. It simply sets back the successional development, or converts what one may term a stable climax association into one of flux with all the inherent vigour of youth and opportunities for development according to the habitat conditions meted out.

The Factor of Light and Shade in Sward Development.

The grass sward to develop must have light. Cocksfoot to a point makes least demand in this respect, while Lotus major, and to some extent brown-top, by stem elongation, reach to the light from within moderately low-growing secondary growth such as hard-fern and short bracken, and in this capability lies partly their great value on secondary-growth country. But taking the grass sward as a sward it cannot tolerate dense shade. Shade is the basal factor underlying the competition concept. One species in a grass sward or in a forest's successional development gives way to or holds mastery over the other according to shade intensity within the association, the species that overshades the others asserting dominance.

In sown grasslands, apart altogether from secondary-growth control, the factor of light and shade governs markedly the composition of the pasture sward. In phases of secondary growth this light-and-shade factor stands out extraordinarily clearly. Close and continuous grazing admits intense light to the soil-surface; the palatable plants are severely pruned and are weakened under this system of grazing, and light-demanding, unpalatable secondary growth, such as piripiri (hutiwai), manuka, and hard-fern, readily establish. If the sward is allowed to rise it shades the ground surface, the trailing stems of piripiri rise off the ground to the light, and stem-rooting is inhibited. The surface stolons of hard-fern are retarded when shaded, and perhaps one of the most noticeable features of the experimental work is the comparatively small spread back of hard-fern against a good sward that is periodically allowed up, as against the rapid spread back against a weak open sward or one that is continuously eaten to the ground. In one experimental paddock two years ago a portion—3 to 4 acres in extent—was fenced off and has since run dairy cows. A square chain of hard-fern had been left in this area as a control plot. Under two years' light grazing by

FIG. 4. ONE OF THE EXPERIMENTAL AREAS IN 1924, BEFORE WORK COMMENCED.

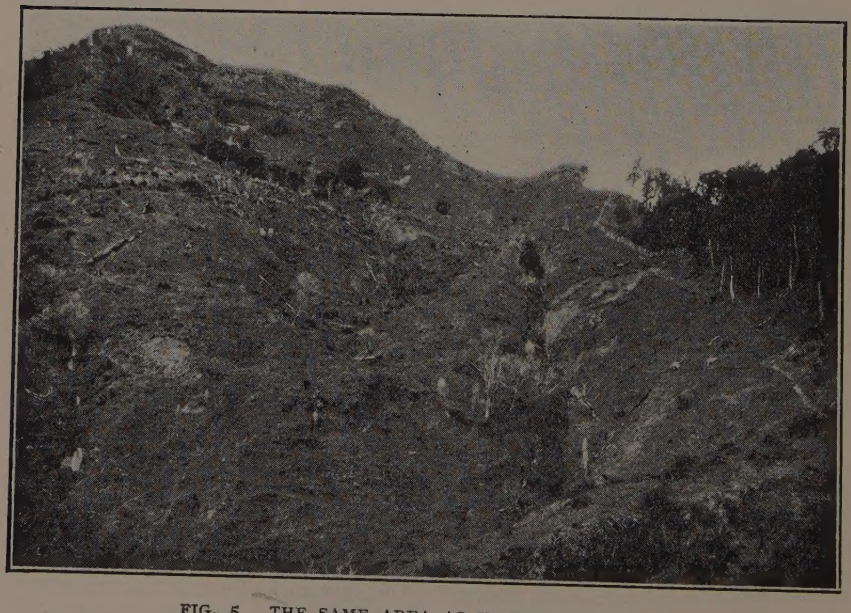

FIG. 5. THE SAME AREA AS IN FIG. 4 IN 1930.

Well grassed, dominantly brown-top, Lotus major, and Danthonia pilosa. Top-dressed once since 1924, and some clearing of patches done in 1928.

[*Photos by E. Bruce Levy.*

dairy cows this control area of hard-fern is now considerably reduced, and the fern has lost all its aggressive vigour.

Shading the ground-surface by a greater and higher sward development, therefore, decidedly prejudices the chances of both piripiri and hard-fern, and, further, greatly inhibits manuka establishment from seed. One has only got to recall to mind the dense manuka patches that occur on slips, the seed establishing there in full sunlight while the ground is yet bare of other vegetation. Tall shading entirely eliminates hard-fern after a period of time, but unfortunately such shading also eliminates the grass sward. Bracken-fern subdues hard-fern by its taller growth. Bracken-fern in turn is subdued by yet taller growths, such as manuka and wineberry.

This but serves to point the way to sward development and to emphasize the impotence of low-growing grasses against taller-growing secondary growth. In order to make a sward that taller growth must be destroyed, or so reduced that light can freely play on to the grass sward itself.

Grass Species persistent among Secondary Growth.

In secondary-growth control one realizes the utter impossibility of totally suppressing all such growth from all aspects of the farm, or even of one paddock, simultaneously. The better areas and lower slopes are fairly readily controlled because there is better grass there to keep stock working the area. In the bringing in of secondary-growth country, therefore, one must anticipate a certain amount of return growth after the fire on the more difficult aspects. For these aspects pasture species that can withstand a certain amount of shade and can persist for a reasonable time in the cover of the secondary growth are of extreme importance. Lotus major stands out pre-eminently successful in this respect. Brown-top, and to a lesser extent Chewings fescue and Danthonia pilosa, can persist for some time among the secondary growth provided this is not too dense, and the value of this persistence is seen when these areas are again fired. The Lotus major, brown-top, Chewings fescue, and Danthonia pilosa withstand excellently the heat of the burn, and with the return of light to their crown tiller well and provide a draw for stock earlier than can be secured by reseeding.

This principle of getting into the country grasses and clovers that can persist among the secondary growth once this gets away, and that can carry a fire well and provide fresh feed soon after the burn, is fundamental to the ultimate control of secondary growth on country too difficult to top-dress and too dangerous to force cattle on.

In the course of the experimental work under review several areas, owing to difficulty of controlling stocking through lack of fences or due to abandonment of the farm, became overrun again with secondary growth. These areas on again being fired and stocked have cleared up far easier, and are being held more easily than hitherto, because of the Lotus major, brown-top, and Danthonia pilosa that was established on the previous burn and which persisted among the return secondary growth, also which came away rapidly after the second clearing up. A third, fourth, or even a fifth clearing up may be necessary, but the important thing is that with plants persisting in the secondary growth

FIG. 6. ANOTHER OF THE EXPERIMENTAL AREAS IN 1924 BEFORE WORK COMMENCED: DOMINANT HARD-FERN, PIRIPIRI (HUTIWAI), AND WEAK TURF.

FIG. 7. SAME AREA AS FIG. 6 IN 1930, BUT MORE DISTANT.

The area is here practically free of secondary growth; dominant brown-top, Lotus major, and Danthonia pilosa, with some Chewings fescue, crested dogstail, white clover, rye-grass, and piripiri. Top-dressed three times since 1924, burnt and part sown in 1928, and sprayed twice.

[*Photos by E. Bruce Levy.*

there is no need to spend more on seed of those species already established there. In the case of the sowings made in Whangamomona prior to 1923 where rye-grass, cocksfoot, and white clover were the main species used, once these weakened, as they invariably did in the second year, there was nothing to compete against the encroaching fern, nothing to draw stock, and nothing to come back once that area was again fired. No material progress was possible, and the ever-recurring expense of seeding the secondary burn proved altogether too expensive. Lotus major and brown-top were introduced there by some settlers prior to the experimental sowings, and Danthonia pilosa was slowly spreading, but never encouraged. Actually what the experimental sowings have done is to greatly hasten the widespread acceptance of brown-top, Lotus major, and Danthonia pilosa as the basis of the sward for that class of country, and the adoption of this from results already secured has put new heart into the settlers, for they are able now to see a definite improvement in the grass cover and a definite slowing-up in return of secondary growth. Moreover, what secondary growth comes away is more readily controlled with the brown-top, Lotus major, and Danthonia pilosa that persist among it.

This improvement in the grass sward and in its density compared with the poor, open, original sward consisting mainly of stunted cocksfoot, sweet vernal, stunted Yorkshire fog, rosette and creeping weeds, is a most marked feature. Patches sown eight years ago are as easily recognized to-day as they were the first and second year after burning and seeding—close dense swards of brown-top, Lotus major, and Danthonia pilosa—with some crested dogstail, white clover, and rye-grass still persisting. I view this close dense sward persisting and in many cases improving after eight years a crowning success of the experimental work not only in the amount of feed such swards produce, but in making the country relatively safe against reinfestation of blown fern spores or inbrought seeds. The open sward previously existing afforded easy establishment for manuka, piripiri, and, in the shady aspects, for bracken and hard-fern spores to become established.

In the results of these experiments the plant ecologist, whose work it is to harmonize the plant population with its habitat, has every cause for satisfaction. Nature on those selfsame hills prior to the felling of the forest had harmonized the tree population with habitat. In the various forms of secondary growth arranged again according to habitat there is further harmony. The possibility of grassing that country lay only in the establishment of a grass sward that was in harmony with each and every aspect. The seed mixtures now recommended for hill country burns in Whangamomona and similar country are as sound as is possible to make them with the species of grasses and clovers at present at our disposal.

Time for Burning and Sowing.

The autumn is the best time for burning and sowing, and the later the burn can be left in the autumn the better. Where possible, seed should be sown as soon after the burn as practicable, except in the case of midsummer burns, when sowing is better delayed until about the middle of March. The prime purpose of the burn actually is to get a seed-bed, and that bed should be made ready at the most favourable time for the seed to germinate and establish. The seeding of

FIG. 8. SLOPE BURNT AND SOWN IN 1925, PHOTOGRAPHED IN 1930.
Top-dressed twice and sprayed once. Brown-top, Lotus major, and Danthonia pilosa dominant.

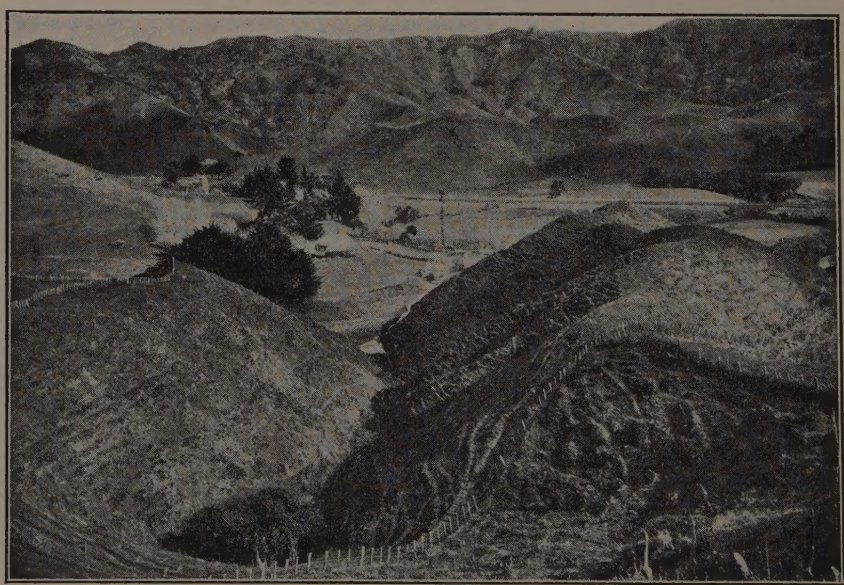

FIG. 9. GENERAL VIEW SHOWING THREE EXPERIMENTAL AREAS.

In foreground 6-acre paddock sprayed, burnt, and sown in 1928; differentially top-dressed in 1929 and 1930. In mid-distance 20-acre paddock sprayed once and cleared up; top-dressed three times since 1924. In mid-background 30-acre area burnt and sown in 1926; top-dressed twice up to time of photo. Carrying-capacity since 1926, three to four sheep per acre.

[*Photos by E. Bruce Levy.*

January and February burns straight after burning is a gamble. If the remainder of the summer proves wet an excellent strike results, but if there is sufficient moisture to germinate the seed and then this is followed by hot, dry weather, the seeding will be a failure. In country like Whangamomona, however, the settler is loath to lose any good opportunity to burn, even spring burning being sometimes practised. There is no doubt seed sown in March on a bed burnt in January or early February gives a very slow and poor establishment compared with the same seeding made on a recent burn provided the weather conditions are favourable for establishment in the latter case. I am inclined to the opinion that where early summer burns are made it is better to leave them until the middle of March, and if the ash has gone to apply a manurial top-dressing as soon as germination is effected. A weakly establishing plant can be strengthened by manure, but a shrivelled-up seedling is gone for good.

Spring burns really should never be made, but if they are it is advisable to sow straight away. In the case of hard-fern the ground is never sufficiently dry in the spring for the fire to roast the rhizome, and within a few weeks there is a new crop. Also in the case of bracken-fern new fronds appear so fast in the spring that stock have to be crowded on before the new sowings are sufficiently well established. In the autumn, if burning weather at all is experienced, the ground is dry and surface rhizomes suffer more severely. Again, in the case of bracken, there is no immediate return of fern fronds to worry about, and the newly sown seed has every chance to become well established before it is necessary to crush hard in the following spring. In a wet season no burning at all should be attempted, as this only ruins the chance of a good sweeping burn once a good burning year comes. The same may be said also of all spring burning. However, once there is established throughout the secondary growth sufficient brown-top, Lotus major, and Danthonia pilosa to come away without further sowing, every available opportunity should be taken—spring or autumn—to remove the shade of the secondary growth by firing or crushing.

Manurial Top-dressing of Hill Country.

The experimental work has shown definitely that control of secondary growth is more certain and can be done with less harm to stock if the area, when sown and the sward established, is also top-dressed with manure. The secret of success, particularly in dealing with bracken-fern, is a high concentration of stock from the beginning of November to the middle of January. If there is present on the area during this period a good flush of grass more stock can be maintained to nip or break off the fern fronds in the curl stage, and thus control is secured without undue forcing. The drawing of stock on to the area rather than forcing certainly appeals as the better practice both for man and beast. The top-dressing of any fern or scrub growth that could be fired and sown down is not recommended. The experiments have shown that, given the same money, to spend on burning and seeding prior to top-dressing is preferable to manuring fern and rubbish as an incentive to draw stock on to crush.

At the present time the Whangamomona sowings are comparatively young, and both brown-top and Lotus major thrive well, the Danthonia

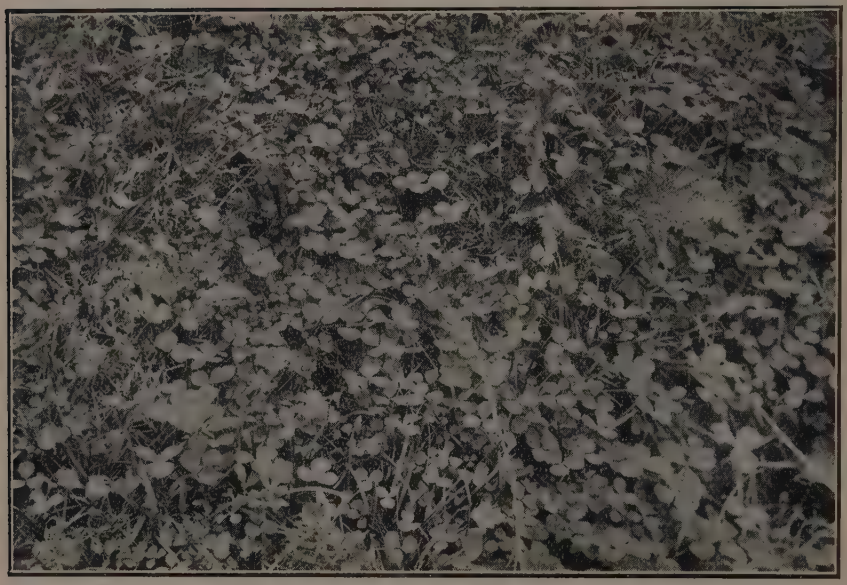

FIG. 10. TOP-DRESSED SWARD SOWN IN 1924.

Dominant white clover, brown-top, and Lotus major, with some crested dogstail and rye-grass. Remnants of hard-fern showing, but spread back against such a turf will be slow. Compare Fig. 11.

FIG. 11. VOLUNTEER SWARD AFTER A BURN.

Sweet vernal, catsear, suckling clover, and stunted Yorkshire fog dominant. Hard-fern is re-establishing, and its spread back against such a turf will be sure and rapid.

[*Photos by E. Bruce Levy.*

being more restricted to the knolls and poorer slopes and aspects. With the drain of soil fertility that must follow years of grazing and removal of herbage there is bound to arrive a state that no longer meets the fertility requirement of brown-top and Lotus major. Then Danthonia pilosa will everywhere become dominant and the carrying-capacity will fall. By top-dressing, say, every third year with 3 cwt. of superphosphate or basic slag per acre on the average country a sward of brown-top and Lotus major, with some white clover, crested dogstail, and rye-grass, is assured, and such should be the aim; but as time goes on, without manuring the best that can be expected from the general slopes is a sward of Danthonia pilosa and suckling clover, with some stunted brown-top and weak Lotus major. The drier and poorer knolls on the experimental areas show this change at the present time, and it is for this reason that the inclusion of Danthonia pilosa in the original mixture sown is so very important. However, even where the soil-fertility has fallen and danthonia has become dominant, the Lotus major is still persisting and is materially helping the danthonia to ward off that dry bottom and dead leafage common in dominant danthonia when unassociated with any clover species.

Manurial trials have been conducted throughout the course of the experiments. Basic slag, superphosphate, basic super, Ephos phosphate, super and lime, super and Nauru ground rock phosphate, and Nauru alone have been tried. In certain cases these manures have been cross-treated with sulphate of ammonia and sulphate of potash. No exact measurement records were possible on the country treated, but, judging from eye-appearance, superphosphate alone appeared to give best results, and superphosphate in combination with lime and Nauru phosphate seemed to give at least results equal to basic slag. The response from sulphate of ammonia is marked for a short period only, and little response if any can be seen from potash dressings. It would appear that super alone or super and Nauru, taking into consideration the ease of handling and spreading this in comparison with basic slag, are the best manures. At present prices money spent for superphosphate would pay better than the same amount spent for any other class of fertilizer.

Fencing.

Control of stock is the first consideration in breaking in secondary-growth country. Many of our experimental sowings were made in 5-acre blocks within large paddocks, where control of stock was quite impossible. Certain of these have been burnt and sown, followed by manuring, until the secondary growth became so dense as to make further work appear foolish, as indeed it was. Obviously, unless stock are working on the area and can be controlled at will, the problem is almost hopeless. Sufficient subdivisional fencing to control stock is imperative.

The Slash-hook and Spray-pump.

The firestick and cattle represent the cheapest implements for the destruction of existing secondary growth wherever these can be satisfactorily employed, but there are certain classes of secondary growth where these implements fail. Burning standing manuka that has set seed, unless a sufficiently hot fire is secured to consume all foliage and seed capsules, results in a fresh and thicker crop of manuka. A fire

skimming through manuka growth usually leaves the seed capsules on, and the heat of the fire acts as a ripening process. The capsules open shortly after the fire and the seed is broadcast into the ash, where good establishment and a fresh crop of manuka is assured. Tutu will not readily burn, and cattle cannot be employed to break it down owing to its poisonous nature. Scrubs like tauhinu, gorse, blackberry, barberry, &c., are also difficult to control by fire and stock alone. No stock will eat hard-fern, and fire alone only serves as a partial remedy. For the complete destruction of these growths the settler has to use additional means, consisting of the slash-hook, the grubber, and the spray-pump, or to pull by hand, as in the case of young manuka.

FIG. 12. APPLYING MANURIAL TOP-DRESSING TO PLOTS WITHIN AN EXPERIMENTAL AREA BURNT AND SOWN IN 1926.

Before clearing up, this entire slope was a mass of hard-fern and piripiri. Photo taken 1930. Of all manures tried superphosphate did the best on this area.

[*Photo by E. Bruce Levy.*

Spraying with arsenic pentoxide has been introduced to deal specifically with hard-fern in the course of these experiments, and particulars of the trials will be given in a later issue of the *Journal*. The use of goats to relieve the slash-hook and grubber in the case of shrubby growths such as tutu, gorse, and blackberry can be widely recommended as an aid to control.

(Series to be continued.)

Silage Losses.—It has been estimated that the loss in a well-built silage stack is 4 to 5 per cent., while in a badly built stack it may be 20 per cent. In the case of a well-constructed pit which has been well filled the loss need not exceed 1 per cent., whereas if the pit is badly filled the loss may range up to 10 per cent.

THE OVERRUN IN BUTTERMAKING.

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THE clause in the Dairy Industry Amendment Act, passed in 1922, requiring manufacturers of butter and cheese to furnish to every milk or cream supplier each year a statement showing the amount of butter and cheese made from each pound of fat received has led to an increased interest in the subject, and the question is frequently asked, What is the overrun? Overrun is usually spoken of as the amount of butter made in excess of the butterfat received. Owing to losses in manufacture, however, and to the allowance of overweight in each box of butter sold, in actual practice it is the amount of butter for which payment is received in excess of the butterfat paid for.

Overrun is made up of the water, salt, and curd which butter contains in addition to butterfat, which is the principal ingredient, but a true overrun does not include the whole of it. Overrun is usually shown as the percentage of butter in excess of the butterfat received, but may be shown as the weight of butter made from each pound of fat paid for. For example, if we pay for 100 lb. of fat and sell 120 lb. of butter the overrun is 20 per cent., and we have made 1·2 lb. of butter from every pound of fat paid for.

Overrun in buttermaking and yield in cheesemaking are the same, but in cheesemaking it is expressed as yield, as, for instance, pounds of cheese made per pounds of fat received = 2·6.

The percentage of overrun is calculated as follows: Butter made — fat received × 100 ÷ fat received = per cent. of overrun. For example: Butter sold, 240 lb.; butterfat paid for, 200 lb.; 240 — 200 = 40 lb.; overrun, 40 × 100 ÷ 200 = 20 per cent. overrun.

FACTORS INFLUENCING AMOUNT OF OVERRUN.

The factors which influence the amount of overrun are: (1) Errors in calculating the amount of fat received; (2) actual losses of fat in manufacturing; and (3) deficiency of matter not fat contained in the finished butter.

(1) ERRORS IN CALCULATING AMOUNT OF FAT RECEIVED.

Under the whole-milk system errors in calculating the amount of fat are not so likely to occur as when handling cream, since the former is weighed in larger quantities, is more liquid and therefore more easily sampled, and the testing is a simpler process. With cream, which is in smaller quantities and contains a higher content of butterfat, the same accuracy is not possible. The tare weights on cream-cans must be marked to half-pounds, and if not exact should be made so by the addition of solder to the bottom of the can. This can be done by the manufacturer, and the weight stamped on a brass plate in 1 in. letters and sweated on to the can. Net weight to $\frac{1}{2}$ lb. must be credited to the supplier, and even then the fractional weights which cannot be credited will give the factory an advantage at this stage.

Sampling, on the other hand, and all other parts of the testing will incline to give the supplier the advantage, with the exception of fractions in reading the test, and the practice of some factories in crediting to ½ per cent. is undoubtedly more accurate. Since these are matters of calculation, the term "loss" under this heading is hardly correct, as no butterfat is actually lost. Want of attention to these details, however, will have a considerable influence on the overrun, and consequently on the payments for butterfat. If all the fat received is paid for and 2 per cent. is allowed for losses in manufacture 100 lb. of fat will make 119·51 lb. of butter where cream is being received, if the butter made contains 82 per cent. of fat. 98 × 100 ÷ 82 = 119·51 lb. butter: overrun, 19·51 per cent. A sample of cream which contains 40 per cent. of fat, if credited to the supplier as 38 per cent., will cause him a loss of 5 per cent. of his total butterfat. Thus on 40 the loss is 2; on 100 the loss is 2 × 100 ÷ 40 per cent. = 5, or for 100 lb. fat received only 95 lb. is paid for. The butter made is still 119·51 lb., and 119·51 − 95 = 24·51 lb. butter made in excess of fat paid for. The overrun will therefore be 24·51 × 100 ÷ 95 = 25·78 per cent. The increase in overrun due to the lower reading of the cream test will be 25·78 − 19·51 = 6·27 per cent., or 3·135 per cent. for each 1 per cent. reduction in test. Similarly, the same error in a 30-per-cent. cream will result in a loss of 6·66 per cent. of fat to the supplier, and the overrun will be increased by 8·40 per cent., or 4·2 per cent. for each 1 per cent. reduction in test. Should the error result in an overcredit of 2 per cent. the overrun will be reduced by 5·84 per cent. when 40 per cent. of cream is being received, and by 7·68 per cent. with 30 per cent. of cream.

Gains.

Apart from actual errors in weighing, &c., there are, as already stated, certain factors which must be allowed for, and as the result of these the amount of fat actually received may be more or less than that paid for.

Tare weights of cream-cans must be marked at the nearest half-pound above the actual weight, and cream may be recorded at the half-pound below actual weight. In each case the law of average will ensure that the factory will gain half the highest possible fractional gain—that is, 3·5 oz. on tare weights and 3·5 oz. on cream, a total of approximately 7 oz. per weighing. The factory having a daily delivery, one which has a large number of small suppliers, or one which weighs all cans singly, will therefore gain more than one having an every-other-day delivery or one following the practice of weighing a number of cans at a time.

Theoretically the gain from this source will be: (Number of weighings × $\frac{7}{16}$ lb.) × average test ÷ 100 = pounds of fat gained. If the average weight of cream in each can is taken at 50 lb. the gain will be 0·875 per cent. ($\frac{7}{16}$ × 100 ÷ 50 = 0·875 per cent.). In actual practice few factory scales are accurate enough at all points to give such a result, or to maintain such accuracy all day and over the whole year under the conditions obtaining in factory work.

Cream tests may be recorded to the nearest full point below actual, and the gain to the factory under this heading will therefore be 0·45

on each test. Taking the average test as 40 per cent. this will amount to 1·125 per cent. of the total fat received if the advantage is taken by the factory in every case. (0·45 × 100 ÷ 40 = 1·125 per cent.).

Although the regulations under the Dairy Industry Act require that the cream weights shall be recorded at the half-pound below actual weight, and tests are generally recorded at the nearest full point below actual, there is nothing to prevent the dairy company recording at the nearest half-pound above actual or the nearest point above actual. This practice was the one commonly followed in the early days of home-separation, but the keen competition which obtains to-day has led to most factories adhering to the letter of the regulation, and figures available indicate that the gain in overrun from this source would be at least 1 per cent. if no losses were incurred to balance the gain.

A further small gain will be made by the factory from fractions which are not paid for when calculating the weight of butterfat.

Losses.

Under the heading of actual losses, dealt with later on, and for which 0·75 per cent. has been allowed, are certain items which are incurred on the receiving-platform. They include amount taken for testing, spillage, fat left in cans and on floats, &c.

The greatest inaccuracy, though not an actual loss, is due to faulty sampling, especially when dealing with cream which is not received daily; in a lesser degree evaporation from samples and testing-scales which are not sufficiently sensitive, all of which will cause a loss to the factory.

The influence of improper sampling will depend on the methods followed in the factory, and cannot be estimated. Sweet cream received daily will not be so difficult to sample correctly, as it can be more easily mixed, and it is then only a matter of getting a proportionate sample from each can.

Sour cream will require a good deal more stirring, the amount required depending on the care which the cream has received on the farm and the length of time it has been held. If it has been left without stirring over a long period it will be almost impossible to get a correct sample without heating, which is not practicable in everyday work. The result will be that the factory will pay for more fat than it receives.

Unless the sample is proportionate to the amount of cream which the can contains, the result may be either a loss or a gain. A large can of thin cream and a small can of rich cream from the same supplier will result in a loss to the factory if the same amount of sample is taken from each, while a gain will result if the large can contains rich cream and the small one thin cream.

A separator set to deliver 40 per cent. cream while 4 per cent. milk is passing through it will deliver approximately 36 per cent. cream when separating 3·6 per cent. milk. This is not an exceptional difference in test between evening and morning milk, and as the weight of evening milk under such conditions is generally considerably less than the morning milk there would be a corresponding difference in the weight of cream. Should the supplier send in each skimming in a separate

can, and an equal quantity be taken from each, his test would be higher than it should be, thus causing a loss to the factory.

In short, all conditions which influence the test of the milk will also influence the test of the cream, and, in addition, there will be the further influences such as temperature, speed of separator, &c., all of which point to the necessity for taking a sample proportionate to the weight of cream in each can received during the whole period. Where daily testing is carried out, the necessity for a proportionate sample as between one delivery and the next will, of course, be done away with.

As a theoretical example the following will illustrate the necessity for proportionate sampling :—

	lb.	Per Cent.		lb. Fat.
One can containing	97	of 36	cream contains	34·92
One can containing	30	of 40	cream contains	12·00
Total	127			46·92

The correct test of the two cans would be 46·92 × 100 ÷ 127 = 37 per cent. One dipper from each would give a test of 36 + 40 ÷ 2 = 38 per cent., and a butterfat content of 127 × 38 ÷ 100 = 48·26 lb. fat, an excess of 1·34 lb., or 2·85 per cent. of fat. If all the fat received were paid for in like manner the overrun would be reduced by approximately 3·4 per cent.

If, on the other hand, the larger can tested 40 per cent. and the smaller one 36 per cent., the factory would gain 1·34 lb. of butterfat, or 2·7 per cent., with a rise of approximately 3·24 per cent. in overrun.

This assumes that the cans were thoroughly stirred, and that the individual tests were correct. Just what would happen if this were not done can be only a matter of conjecture, but the common experience of butter factories is that the overrun drops sharply in the winter, indicating the difficulty of getting a correct sample of thick viscous cream.

A change in the man doing the sampling has been known to cause a drop of 5 per cent. in the overrun at a factory, and the same difference has been known to be due to evaporation from the sample bottles.

Although the foregoing remarks have dealt with cream, the effect is the same in a lesser degree where milk is handled. The fractional margins in weighing will be very small, but, in testing, the position will be practically the same, while sampling will be a much simpler matter on account of the fluid nature of the milk.

With a view to obviating these discrepancies in cream-testing the simple methods of testing by composite sample and payment on butterfat have been varied in other dairying countries, and more complicated procedure is required, such as (1) Weighing and testing of individual cans of cream belonging to one supplier, unless the whole of the cream is emptied into one receptacle ; (2) daily testing of all cream received, daily calculation of the fat content, and in some cases a daily estimation of the weight of butter it will produce ; (3) payment on the manufactured article, either butter or cheese ; (4) adjustment of the overrun to a standard by all factories. All of these have for their object the prevention of errors in testing, and the elimination of the advantage gained by the factory as a result of these errors when payment is made on butterfat.

(2) ACTUAL LOSSES OF FAT.

Two systems of butter-manufacture are in operation under factory conditions—namely, (1) butter made from whole milk received, and (2) butter made from cream received; these two systems are generally spoken of as "whole milk" and "home separation." A few factory concerns operate both systems.

The actual loss of fat under the whole-milk system averages probably 4 per cent. of the fat received in the milk, and under the home-separation system 2 per cent. of the fat received in the cream. Under the whole-milk system the actual losses of fat may be classified under four heads: (1) Loss in skimming milk, (2) loss in handling cream and butter; (3) loss in buttermilk; and (4) loss in packing butter. In the home-separation system the actual losses come under the last three heads.

The percentage of fat lost in skim-milk and in buttermilk can be ascertained by means of the butyl alcohol Babcock test. This test gives results corresponding closely to results obtained by gravimetric analysis, and shows higher and more correct results than are readable in the ordinary Babcock test. The test is, briefly, 2 c.c. of normal butyl alcohol, 9 c.c. of milk, and 7 to 9 c.c. of 1·82–1·83 specific gravity sulphuric acid, placed in a 0·5 graduated bottle, whirled 6–2–2 minutes, and the reading doubled.

Skim-milk is generally about 85 per cent. to 90 per cent. of the whole milk, and contains nominally about 0·09 per cent. of fat. This loss varies, and losses as high as 0·1 to 1·13 per cent. have been reported. When milk containing 4 per cent. of fat is separated the loss of fat from that received in the milk is approximately 2·0 per cent. Thus 90 lb. of skim-milk contains $0·09 \times 90 \div 100 = 0·081$ lb. fat. From 4 lb. fat in milk the loss is 0·081 lb. From 100 lb. fat in milk the loss is $0·081 \div 4 \times 100 = 2·025$ per cent. The loss of fat in handling cream from the separator to the pasteurizer, in running it to the churn, and in the handling of the resultant butter (exclusive of the loss in buttermilk), and in packing or pounding the butter, is difficult to estimate, but can reasonably be set down at 0·75 per cent. of the fat received.

The amount of buttermilk from cream containing 40 per cent. of fat, including an allowance for water used in handling and churning, may be stated at about 65 lb. per 100 lb. and a normal percentage of fat in the resultant buttermilk is about 0·65, though as a result of the use of the butyl alcohol test it has been ascertained that the test of buttermilk from different churnings may range to as high as 1·5 per cent. A test of 0·65 per cent. is equal to a loss of 0·978 per cent. of the total fat received. Allowing 12 per cent. of the weight of fat as the weight of serum retained in the churned butter, we have $(65 - 4·8) \times 0·65 \div 40 = 0·978$ per cent., or 1 per cent. in round figures.

Boxes of bulk butter usually contain 56 lb. 6 oz., including the weight of the wrapping-paper, which, when taken off, weighs about 4 oz. It is customary to place 2 oz. of butter in each box and make no charge for it, to allow for possible shrinkage and other wastage. A similar allowance is sometimes made for unavoidable losses incurred in

pounding up each 56 lb. of butter for local trade. With butter containing 82 per cent. of fat the loss is 0·222 per cent. of the fat contained in the butter.

It is recognized that some of the losses have in practice occurred before that stage of manufacture has arrived for which later losses have been calculated. The variations thus caused are, however, of no practical significance for our purposes, as they affect only the second place of decimals.

In each system the actual losses of the fat received are therefore approximately as follows :—

Under Whole Milk.

	Per Cent.
Skim-milk	2·0
Handling cream and butter	0·75
Buttermilk	1·00
Packing butter	0·222
Total	3·972

Under Home Separation.

	Per Cent.
Handling cream and butter	0·75
Buttermilk	1·00
Packing butter	0·222
Total	1·972

The constituents of butter are generally noted in short analyses under four heads as (1) fat, (2) water, (3) salt, (4) curd and ash. The average fat content of New Zealand butter is about 82·5 per cent., but under exceptional circumstances it may be as low as 82 per cent., plus 15·5 per cent. of water, 1·75 per cent. of salt, and 0·75 per cent. of curd and ash. There are few factories which maintain this composition from day to day, however, and it must be regarded as a possible but not probable performance.

The overrun under the whole-milk system when butter of such composition is made, and the loss of fat is 4 per cent. of the fat received in the milk, will be 17·07 per cent. Thus, 100 — 4 = 96 lb. fat sold in butter; 96 × 100 ÷ 82 = 117·07 lb. butter made per 100 lb. fat purchased in milk, giving an overrun of 17·07 per cent.

Under the home-separation system, and when the loss of fat is 2 per cent. of the fat received in the cream, the overrun will be 19·51 per cent., as shown on page 94.

If it were possible to manufacture fat into butter without loss, and to maintain the legal minimum of 80 per cent. of fat in the butter, it would be possible to make an overrun of 25 per cent. Since 80 lb. fat—the legal minimum percentage—would make 100 lb. butter, 100 lb. fat would make 125 lb. butter, or an overrun of 25 per cent. But as manufacturing losses do occur, if we assume these to be as indicated above, the overrun will be as follows :—

Under whole milk 100 lb. fat received, less 4 lb. lost, equals 96 lb. fat retained in butter sold. If 80 lb. of fat makes 100 lb. of butter, 96 lb. fat would make 96 × 100 ÷ 80 = 120 lb. butter, or an overrun of 20 per cent.

Under home separation 100 lb. fat received, less 2 lb. lost, equals 98 lb. fat retained in the butter sold. If 80 lb. fat makes 100 lb. butter, 98 lb. fat would make 98 × 100 ÷ 80 = 122·5 lb. butter, or an overrun of 22·50 per cent. As the fat content of butter is sometimes as high as 85 per cent., however, and as 80 per cent. is seldom found, a fat content of 82 per cent. may be taken as being below the average.

At first sight the foregoing figures would seem to indicate that the home-separator factory is the most profitable to supply. The whole-milk factory pays for all the butterfat which the milk contains, while the home-separator factory pays for all the butterfat contained in the cream which it receives. Each 100 lb. of fat delivered in the cream represents at least 102 lb. produced on the farm when allowance is made for losses in skimming.

The whole-milk factory makes 117·07 lb. of butter from each 100 lb. of fat paid for, and, if it receives 1s. per pound of butter net, can pay out 117·07s. ÷ 100 = 14·0484d. per pound butterfat. The home-separator factory makes 119·51 lb. butter from each 100 lb. fat paid for and can pay 119·51s. ÷ 100 = 14·3412d. per pound of butterfat. But if the supplier allows for losses in skimming he receives only 119·51s. ÷ 102 = 14·06d. per pound of fat produced, so that the advantage is more apparent than real.

(3) DEFICIENCY OF MATTER NOT FAT.

The amount of matter not fat which butter may contain is limited by legal enactment, which requires that butter shall contain not less than 80 per cent. of milk fat (butterfat) and not more than 16 per cent. of water. These two requirements conform to those current in the markets to which New Zealand butter is shipped. In most of the markets in Great Britain a salt content exceeding 2 per cent. is objected to, and to meet this position a further regulation limits the amount of salt to that figure. Complaints of oversalting have been received regarding butter which contained less than 2 per cent., and 1·5 per cent. has at times been found to be excessive when making butter from ripened cream. Allowing a maximum of 16 per cent. of water and 2 per cent. of salt, plus 1 per cent. of curd—a total of 19 per cent. of matter not fat—it will be seen that the minimum of fat possible will be 81 per cent., except under exceptional circumstances such as when making for the American market, which requires from 3 to 3·5 per cent. of salt. In such circumstances the fat content of the butter will be reduced and the overrun increased. When making unsalted butter the result will be the opposite—the fat content of the butter will increase and the overrun will be reduced.

When making for the British market, it can be regarded as exceptionally good work if butter is made which averages: fat, 81·5 per cent.; water, 15·7 per cent.; salt, 1·8 per cent.; and curd, 1 per cent. The overrun if this average is maintained would therefore be—whole milk, 17·79 per cent.; home separation, 20·25 per cent. if all the fat received is paid for.

A careful check can be kept on the various constituents of the butter made, by means of the several tests with which all buttermakers are familiar, provided a representative sample of the butter in the churn is obtained. To do so it is necessary to take small pieces of butter from different parts of the churn and emulsify and thoroughly mix them. Tests may be made from the same sample in the following order: Moisture, by the drying-off method; fat, by the benzine process; salt, by the silver nitrate test; and curd and ash, by subtracting the total of the first three from one hundred.

The accompanying table shows the overrun obtainable under varying conditions, and gives an indication whether the losses under either

Table 1.—Overrun obtainable under Varying Conditions.

Composition of Butter.		Percentage of Manufacturing Losses.																
Fat Per Cent.	Matter not Fat Per Cent.	0	0·25	0·50	0·75	1·0	1·25	1·5	1·75	2·0	2·25	2·5	2·75	3·0	3·25	3·5	3·75	4·0
		Percentage of Overrun.																
80·00	20·00	25·00	24·68	24·37	24·06	23·75	23·43	23·12	22·81	22·50	22·18	21·87	21·56	21·25	20·93	20·62	20·31	20·00
80·25	19·75	24·61	24·29	23·98	23·67	23·36	23·05	22·74	22·42	22·11	21·80	21·49	21·18	20·87	20·56	20·24	19·93	19·62
80·50	19·50	24·22	23·91	23·60	23·29	22·98	22·67	22·36	22·04	21·73	21·42	21·11	20·80	20·49	20·18	19·87	19·56	19·25
80·75	19·25	23·83	23·52	23·21	22·91	22·60	22·29	21·98	21·67	21·36	21·05	20·74	20·43	20·12	19·81	19·50	19·19	18·88
81·00	19·00	23·45	23·14	22·83	22·53	22·22	21·91	21·60	21·29	20·98	20·67	20·37	20·06	19·75	19·44	19·13	18·82	18·51
81·25	18·75	23·07	22·76	22·46	22·15	21·84	21·53	21·23	20·92	20·61	20·30	20·00	19·69	19·38	19·07	18·76	18·46	18·15
81·50	18·50	22·69	22·39	22·08	21·77	21·47	21·16	20·85	20·55	20·24	19·93	19·63	19·32	19·01	18·71	18·40	18·09	17·79
81·75	18·25	22·32	22·01	21·71	21·40	21·10	20·78	20·48	20·18	19·87	19·57	19·26	18·96	18·65	18·34	18·04	17·73	17·43
82·00	18·00	21·95	21·64	21·34	21·03	20·73	20·42	20·12	19·81	19·51	19·20	18·90	18·59	18·29	17·98	17·68	17·37	17·07
82·25	17·75	21·58	21·27	20·97	20·66	20·36	20·06	19·75	19·45	19·14	18·84	18·54	18·23	17·93	17·62	17·32	17·02	16·71
82·50	17·50	21·21	20·90	20·60	20·30	20·00	19·69	19·39	19·09	18·78	18·48	18·18	17·87	17·57	17·27	16·96	16·66	16·36
82·75	17·25	20·84	20·54	20·24	19·93	19·63	19·33	19·03	18·73	18·42	18·12	17·82	17·52	17·22	16·91	16·61	16·31	16·01
83·00	17·00	20·48	20·18	19·67	19·57	19·27	18·97	18·67	18·37	18·07	17·77	17·46	17·16	16·86	16·56	16·26	15·96	15·66
83·25	16·75	20·12	19·8	19·51	19·21	18·91	18·61	18·31	18·01	17·71	17·41	17·11	16·81	16·51	16·21	15·91	15·61	15·31
83·50	16·50	19·76	19·46	19·16	18·86	18·56	18·26	17·96	17·66	17·36	17·06	16·76	16·46	16·16	15·86	15·56	15·26	14·96
83·75	16·25	19·40	19·10	18·80	18·50	18·20	17·91	17·61	17·31	17·01	16·71	16·41	16·11	15·82	15·52	15·22	14·92	14·62
84·00	16·00	19·04	18·75	18·45	18·15	17·85	17·55	17·26	16·96	16·66	16·36	16·07	15·77	15·47	15·17	14·88	14·58	14·28
84·25	15·75	18·69	18·39	18·10	17·80	17·50	17·20	16·91	16·61	16·31	16·02	15·72	15·43	15·13	14·83	14·54	14·24	13·94
84·50	15·50	18·34	18·04	17·75	17·45	17·15	16·86	16·56	16·27	15·97	15·68	15·38	15·08	14·79	14·49	14·20	13·90	13·60
84·75	15·25	17·99	17·69	17·40	17·10	16·81	16·51	16·22	15·92	15·63	15·33	15·04	14·74	14·45	14·15	13·86	13·56	13·26
85·00	15·00	17·64	17·35	17·05	16·76	16·47	16·17	15·88	15·58	15·29	15·00	14·70	14·41	14·11	13·82	13·52	13·23	12·94

of these headings have been excessive, providing all and only the butterfat received has been paid for. It will be noted that when the butter made contains 82 per cent. of fat, the loss of each 1 per cent. of fat in manufacturing reduces the overrun approximately 1·22 per cent. The loss of 1 per cent. in matter not fat, such as a low water content, reduces the overrun 1·48 per cent. approximately. The aim of the buttermaker will be, then, to retain as much water in the finished butter as the legal standard will allow, and the maximum amount of salt, having due regard to the taste of the buyer, since any deficiency in either must be made up with butterfat and the overrun be thereby reduced. In the first case there is an actual loss of 1 lb. of fat in every 100, plus the matter not fat which could have been added to it. In the second there is no actual loss of fat, but 1 lb. has been added to every 82 lb. to replace a deficiency of salt or water and the loss is 1 lb. of fat in every 83 lb. used, plus the difference between 17 and 18 per cent. of matter not fat, which is added to each pound of fat contained in the butter. Hence a composition loss is a greater one than a manufacturing loss.

True Overrun.

Accepting 82 per cent. in the butter as better than average work, and losses in manufacture as 4 per cent. under whole milk and 2 per cent. under home separation, it follows that any overrun in excess of 17·07 per cent. and 19·51 per cent. must be obtained as the result of receiving fat which was not paid for. In the case of milk each 1 per cent. of fat so gained will make a difference of about 1·2 per cent. in overrun, and with cream a difference of about 1·22 per cent. The amount will vary with the test of the milk being skimmed and the test of the cream churned, a low test in both cases resulting in a higher percentage loss of fat.

As stated on page 93, a true overrun does not include the whole of the matter not fat contained in the butter. Thus if 98 lb. of fat makes 119·51 lb. of butter there must be 21·51 lb. of water, &c. But the overrun is only 19·51 per cent., as the manufacturing losses—2 per cent.—have to be taken from it and added to 98 to make it up to 100 on which the overrun is calculated.

An overrun which was the same percentage as the weight of water, &c., contained in the weight of butter made per 100 lb. of fat paid for would indicate that butterfat equal to the manufacturing losses had been received but not paid for. If it exceeded that amount the gain so made must have been that much greater, as the following table will show :—

Table 2.

Butter made.	Fat in Butter.	Water Salt Curd.	Fat paid for.	Amount of Overrun.	Percentage of Overrun.
Lb.	Lb.	Lb.	Lb.	Lb.	
119·51	98	21·51	100	19·51	19·51
119·51	98	21·51	98	21·51	21·95
119·51	98	21·51	96	23·51	24·48

In the first case the weight of overrun is reduced by the pounds of fat lost in manufacture, and the percentage of overrun is reduced by that amount. In the second the weight of overrun is the same as the weight of water, &c., and the percentage of overrun exceeds it, indicating that the loss in manufacture was recovered from fat received but not paid for. In the third the weight of overrun exceeds the weight of water, &c., indicating that the loss in manufacture, plus a further 2 lb., was recovered from fat received but not paid for.

Thus a true overrun does not include the whole of the water, &c., contained in the butter, while a false overrun contains some fat which has not been paid for.

Influence of the Overrun on Payments for Fat.

The influences of the overrun on the payment for fat may be seen in this way: If we have 100 lb. of fat and make 120 lb. of butter worth 1s. per pound, 1 lb. of fat is worth 120s. ÷ 100 = 14·4d. But if only 115 lb. of butter is made from 100 lb. of fat, 1 lb. of fat is worth only 115s. ÷ 100 = 13·8d.: or 1s. × 1·15 = 13·8d. The value of the overrun per pound of fat is therefore in the first case 14·4d. — 12d. = 2·4d., and in the second 13·8d. — 12 = 1·8d.

If the expense of making and marketing amounts to 1·8d. per pound of fat the factory will be able to pay out 1s., the same price as received for butter when the overrun is 15 per cent., but if the expenses exceed 1·8d. the payment for butterfat will be less per pound than was received for butter; but with a 20-per-cent. overrun and the same manufacturing costs the factory can pay 14·4d. — 1·8d. = 12·6d. per pound, or 0·6d. more than was received per pound for butter. Assuming that each supplier has been credited with his correct amount of fat, and that the reduced overrun is the result of faulty manufacturing methods, the loss falls equally on all suppliers. But should the low overrun be the result of error in weighing, testing, &c., it is only one of calculation, and will fall unfairly on certain suppliers.

Taking three suppliers sending in 30, 40, and 50 per cent. cream, and assuming that they are credited with 31, 41, and 51 tests: the first will be paid for 3·33 per cent. too much fat; the second will be paid 2½ per cent. too much; and the third will be paid for 2 per cent. too much. Since the percentage of error is not evenly distributed, and there is only a certain sum available for distribution, the first will receive more money than he is entitled to, the second will receive about the correct amount, and the third less than he is entitled to, in spite of the fact that one point has been added to his test. Should the error result in a similar reduction in test the first will receive less than his due, the second will receive about the same as before, and the third more money than he is entitled to, although his test has been read down a point.

Assuming that each of these suppliers delivered 1,000 lb. of cream during the period, that the overrun obtained by the factory was 20 per cent., and that the value of the butter was 1s. per pound after all expenses were paid,—

(*a*) Pounds of fat actually delivered 300 + 400 + 500 = 1,200 lb.
Butter made with a 20-per-cent. overrun, 1,440 lb.
Amount available for distribution, 1,440 lb. at 1s., 1,440s.
The price paid per pound of fat would be 1,440s. ÷ 1,200 = 14·4d.

(*b*) If the tests were overread 1 per cent. the fat paid for would be 310 + 410 + 510 = 1,230 lb.
The butter made would still be 1,440 lb., worth 1,440s.
The overrun would be 1,440 — 1,230 = 210 / 100 ÷ 1,230 = 17·07 per cent.
The price paid per pound of fat would be 1,440 ÷ 1,230 = 14·048d.

(*c*) If the tests were underread 1 per cent. the fat paid for would be 290 + 390 + 490 = 1,170 lb.
The butter made would still be 1,440 lb., worth 1,440s.
The overrun would be 1,440 — 1,170 = 270 / 100 ÷ 1,170 = 23·07 per cent.
The price paid per pound of butterfat would be 1,440s. ÷ 1,170 = 14·769d.

Collectively the three suppliers would receive the same under all conditions—

1,200 lb. of fat at 14·4d. = 1,440s. distributed.
1,230 lb. of fat at 14·048d. = 1,440s. distributed.
1,170 lb. of fat at 14·769d. = 1,440s. distributed.

Individually they would receive more or less than they were entitled to according to the testing of the cream. The actual amount which each should receive would be—

	s.
(1) 300 lb. fat at 14·4d. =	360
(2) 400 lb. fat at 14·4d. =	480
(3) 500 lb. fat at 14·4d. =	600
Total	1,440

If the tests are overread 1 per cent.,—

(1) 310 lb. of fat at 14·048d. = 362·906s.; gain, 2·906s.
(2) 410 lb. of fat at 14·048d. = 479·973s.; loss, 0·027s.
(3) 510 lb. of fat at 14·048d. = 597·04s.; loss, 2·96s.
Total—
1,230 lb. of fat at 14·048d. = 1,439·819s.

If the tests are underread 1 per cent.,—

(1) 290 lb. of fat at 14·769d. = 356·917s.; loss, 3·083s.
(2) 390 lb. of fat at 14·769d. = 479·972s.; loss, 0·028s.
(3) 490 lb. of fat at 14·769d. = 603·076s.; gain, 3·076s.
Total—
1,170 lb. of fat at 14·769d. = 1,439·976s.

So far as the dairy company is concerned it is in the same position whether it pays for 1,230 lb. fat at 14·048d. per pound or 1,170 lb. of fat at 14·769d. per pound, but the effect on the amount which the supplier will receive will depend on his test. The nearer the test is to the factory average the less will it be affected by inaccuracies in testing.

As stated on page 94 there are two methods of payment other than butterfat which have been adopted in dairying countries in order to minimize the advantage gained by the factory in the rate of payment per pound as the result of receiving fat which is not paid for. These are payments on the finished butter and standardization of the overrun.

Taking A, B, and C as three factories, the effect of the first method would be as follows :—

(A) The factory having credited all the fat received and made a normal overrun would obviously pay out 1s. per pound, the net price received, on a butter basis. This figure can also be calculated as follows : Price paid per pound fat ÷ yield per pound fat = price paid per pound of butter. 14·4d. ÷ 1·20 = 12d. per pound of butter.

(B) Price paid per pound of fat 14·048d. ÷ 1·1707 = 12d. per pound of butter.

(C) Price paid per pound of fat 14·769d. ÷ 1·2307 = 12d. per pound of butter.

An error in the calculation of the amount of butterfat does not affect the amount of butter made in any way, and consequently the price paid on a butter basis can be influenced by the price received and the cost of manufacture only. An actual increase in the amount of butter made from a given quantity of fat will increase the number of pounds of butter to be paid for, but not the rate per pound. Conversely, a reduction in the amount made will decrease the number of pounds paid for, but not the rate per pound.

The system, therefore, has the advantage that the rate paid per pound is not inflated as the result of receiving fat which is not paid for. It does not give credit to the factory actually making more butter than its competitors from a given amount of butterfat. It does not prevent inferior work being covered up by reading down tests in order to make up for composition and manufacturing losses, and thus give an overrun which is normal. The total sum received by each supplier would not be affected, since the amount paid for would be based on the fat credited plus the percentage of overrun.

Under the standardized overrun method the position would be as follows if the standard were fixed at 20 per cent. :—

A, having a standard overrun, would have no adjustment to make and would pay 14·4d. per pound of fat.

B, having made such a small amount of butter from the weight of fat paid for, would require to look into his methods of testing and manufacture and eliminate the cause, since he could not be allowed to make an adjustment at the expense of the supplier.

C, having paid for less fat than was received, would have to increase the amount credited to each supplier as follows :—

$$\frac{1{\cdot}2307 \times 100}{1{\cdot}20} = 102{\cdot}5 \text{ lb. fat received for each 100 lb. paid for.}$$

$$\frac{1{,}170 \times 102{\cdot}5}{100} = 1{,}199{\cdot}25 + (1{,}200) \text{ lb. of fat actually received.}$$

$$\text{Overrun} = \frac{(1{,}440 - 1{,}200)\ 100}{1{,}200} = 20 \text{ per cent.}$$

Price paid : 1,440s. ÷ 1,200 = 14·4d. per pound of fat.

Similarly to the payment on butter, the total sum paid to each supplier is not altered, as any error in the method of determining his fat is not corrected. From the New Zealand point of view this has the advantage that it retains the fat basis of payment. It has the merit of discouraging any attempt to get an overrun in excess of the

figure set, at the expense of the supplier, but might be an inducement to factories to reach the standard at any cost. No method has yet been devised, however, which will rectify the unfairness to the supplier which is the result of incompetent or dishonest work in the factory.

Conclusion.

From the foregoing it will be seen that the overrun plays a very important part in the affairs of a dairy factory, and the necessity for checking it at each testing-period cannot be too strongly emphasized. The greatest care is required from the time the milk or cream is received until the butter is packed, and each step of the process must be carefully checked in order to avoid unnecessary losses.

Putting aside the accurate testing of milk and cream, which have been fully dealt with on many occasions, practical and reliable tests are available with which all buttermakers are familiar. Of these the moisture and salt tests are the most important, as these two ingredients practically determine the fat content of the butter and to a great extent the overrun. Manufacturing losses cannot be reduced below a certain minimum, as a percentage of loss is unavoidable, while the curd content of butter cannot be increased without endangering the keeping-qualities of the butter. The factors of moisture and salt, however, are, within certain limits, in the hands of the buttermaker.

The belief seems to prevail among factory-suppliers that the buttermaker making a high overrun has some knowledge which is not possessed by his more moderate competitor. There are only two means whereby an overrun can be increased without loss to the supplier—namely, reduction in the fat content of the finished butter, and reduction in the manufacturing losses. The possible saving in each case would not exceed ½ per cent. when comparing the work done by two well-managed factories, and the first will give an increase of approximately 0·74 per cent. in overrun, while the second will give approximately 0·61 per cent. increase, a total of 1·35 per cent. Accepting 19·51 per cent. as a normal overrun when all fat is paid for, the maximum would therefore be 20·86 per cent. under the home-separation system, and any further increase must be due to the receipt of fat not paid for.

Rimu Poles for Telegraph and Power Lines.—The annual report of the State Forest Service for 1930–31 refers to developments in this direction as follows: "In an effort to meet a greater portion of the local demand for telegraph and power poles, most of which are at present imported, strength and preservation tests of full-sized rimu poles were carried out with considerable success. The coastal type of rimu forest in Westland and Southland yields poles of excellent shape and strength, and with the development of suitable treating methods, which is contingent upon the establishment of an experimental pressure treating plant, it is anticipated that a thriving industry may soon be established. Approximately 100 poles treated by the non-pressure process have now been placed in use, and will be carefully inspected at regular intervals along with the numerous treated fence-post lines installed in previous years. These service test lines have now definitely established the fact that in most localities a butt treatment is insufficient, and that posts, poles, &c., must receive a fairly heavy full-length preservative treatment to give a satisfactory life."

ELIMINATION OF SMUT DISEASES FROM THE MALTING-BARLEY CROPS OF ELLESMERE DISTRICT.

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THE Ellesmere district of Canterbury produces about one-half of the total New Zealand output of malting-barley—some 5,000 to 6,000 acres being grown annually in crops of an average size of about 25 acres. Until the year 1925 loose smut, covered smut, and stripe disease were present to a greater or lesser extent in every crop, covered smut in particular being very prevalent and the cause of severe losses.

In that year the Canterbury (N.Z.) Seed Co., Ltd., who are the principal buyers of barley in the district, installed a plant for the treatment of cereal seed by a modification of the Jensen hot-water method. In each succeeding year selected lines of barley have been treated and grown—chiefly on the company's own farms—to provide sufficient seed to supply the wants of their contract growers. All these crops "direct from treatment" have remained free from smut, and practically free from stripe.

The product—"once-removed from treatment seed"—has also produced smut-free crops, since from the beginning great care has been taken to prevent recontamination in handling. This seed, producing as it did crops high in yield and in quality of grain, free from smut, soon came into general favour in the district, so that by 1929 practically all barley sown was once or twice removed from the hot-water treatment.*

Each year since 1925 disease surveys of the district have shown a steady decrease in the incidence of these seed-borne diseases. Loose smut, infection with which can take place only in the growing crop, was soon eliminated—none having been detected since the 1928–29 season. Covered smut, infection with which is largely due to spores adhering to the grain, and which consequently can be conveyed to clean seed by contaminated threshing and cleaning machines, took longer—a trace being detected in two crops in 1930–31, but none in the 1931–32 season. Stripe disease, though greatly reduced, was still present as a trace only in 21 per cent. of the crops in 1931–32.

No contracts for barley have been let during the present season, and in consequence a large proportion of the growers have used their own seed. Much of this seed has been through the common travelling threshing-mills, with no special precautions to avoid reinfection, so that the entire freedom of all crops from both smuts indicates that these diseases have been eliminated from the district. This result, which has been accompanied by a large increase in acre-yield and in quality of grain, has demonstrated the possibility—and the advantages—of this method for the control of seed-borne crop diseases.

In essence the method consists in the gradual replacement of infected seed within a definite area by the distribution of constantly renewed

* Hewlett, C. H., *N.Z. Jour. of Agric.*, Vol. 40, p. 104, 1930.

supplies of disease-free seed selected and bred under skilled supervision. Its success in the present case has been achieved by close co-operation between the Plant Research Station and the Canterbury Seed Co.

"BUSH SICKNESS" AND "DOPINESS": SOME COMPARISONS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

As a considerable amount of confusion exists in the minds of many of those interested in the difficulties of "bush sickness" and "dopiness" attending sheep-farming in certain North Island districts, it is desirable that the points of difference which lead a chemist to suspect distinctness in these troubles should be enumerated. Both are what are called "deficiency diseases"—that is, they are due to something deficient in the diet. The proof of this is that veterinary pathologists fail to find any transmissible disease or parasitic infestation sufficient to account for the heavy mortality, that suitable food and water are present in sufficient amounts, and that the animals recover if removed to what is known locally to be healthy country, although this may be quite near that upon which they became sick.

Bush sickness is a wasting disease of the deficiency type characterized by emaciation and bloodlessness (anæmia) of the animal. The intensity of the disease is related to the coarseness of the soil. The coarser soil is found where animals are worst affected, the disease appearing in its mildest form on the finest of these affected soils. Typical bush sickness has so far not been found on any but very coarse-textured soil, which is technically* known under the terms "sandy silt," "coarse sand," or "fine gravelly sand." This is so not only with the disease in New Zealand, but also where a similar or the same disease occurs in Tasmania, South Australia, Kenya, the Cheviot Hills in Scotland, and Florida. Dune sands in various New Zealand localities when fixed and grassed are also believed to give rise to something similar to bush sickness in sheep.

In typical bush sickness as it occurs on coarse pumice soils ruminants never show any deterioration of the bones, which are always exceptionally well formed, indicating that an adequate supply of lime and phosphate has been obtained from the pasture. It has always been thought that bush sickness was restricted to ruminants (sheep, cattle, goats, deer), and that horses and all other herbivorous animals were immune although eating the same pasture that was available for the ruminants which became bush-sick. There are signs, however, that this conception will have to be revised. In Florida it is asserted that pigs suffer from anæmia when grazed on pasture on which cattle suffer from a deficiency disease officially said to be the same as the New Zealand bush sickness. Goats and sheep also suffer on this Florida soil. Again, at Mamaku and Kaharoa rabbits, although occurring sparsely, do not increase normally on these types, and appear to be migrants from healthy country.

* "Technically" refers to the special use of those terms in soil science. For instance, "the clay of the soil chemist is not the clay of the geologist" (Robinson).

Bush-sickness soils rapidly improve under occupation and utilization, the incidence of the disease being at its worst after the forest is burnt. Thereafter with grassing, stocking, and ultimately logging, ploughing, cultivating, cropping, resowing, and top-dressing, gradually the disease diminishes. Clovers are always evident in bush-sick pastures, and sometimes very abundant after top-dressing with phosphates.

Dopiness occurs in sheep, only on soils which are derived from volcanic dust or mud showers. These soils are not coarse-textured, but belong to that great class technically called "loams," on which most of the agriculture of the world is conducted. Clovers are deficient in these pastures, and the bones of affected animals are very light in weight. Chemical tests of the soils indicate a great deficiency of lime. Theoretically about 10 tons of carbonate of lime per acre would be required to satisfy the full absorption capacity. Leaching of the soils by rain has been strongly stressed by geologists as the cause of the deficiency disease, and this would accord with great lime deficiency, since phosphates are not leached from soils in appreciable amounts. The tendency for phosphates is to rise in the soil by the action of life and to become concentrated in the upper layers where leaves and bark of trees and the remains of animals decay, having obtained the phosphate they require from beneath the surface.

Soils on which dopiness occurs may be rightly called "deteriorated soils," at one time having been highly productive—that is, they are at their best immediately after a bush burn. The burning of the forest supplies anything up to ½ ton of ashes per acre; these consist mostly of carbonate of lime, which is gradually converted into bicarbonate, leached out, and lost. The pasture growing on these ashes is at its highest productive capacity within a couple of years after the burn. After this it slowly deteriorates, the sward changing gradually from rye-grass and white clover until finally only grasses such as Chewings fescue, danthonia, and brown-top remain.

Field experimentation in connection with both these diseases is greatly handicapped from the fact that abnormal seasons affect the incidence of the disease. In some years the mortality will be exceptionally high, in other years extremely low, so that the positive results which may be expected in normal years are obliterated by the general high or low mortality due to an unknown cause. Especially is this so in regard to sheep, which are injuriously affected by an abnormal rate of growth in the pasture difficult to control, probably due to exceptional seasonal effects, and which decidedly acts as an interfering factor in any experiments made with sheep. Extreme care is therefore required in the management of the pasture so as to keep it in a condition suitable for sheep.

Another marked difference in the response of the two types of soil suffering respectively from bush sickness and dopiness is in the way they respond to calcium applications. This element undoubtedly has very great influence for good on the dopiness soil when used either as lime itself or as salts of lime, with calcium phosphates (superphosphate, &c.), and calcium sulphate. It is impossible to grow cruciferous crops such as turnips, cabbages, rape, &c., without lime carbonate, and if attempted club-root affects them. Pasture is considerably improved by

lime and especially by superphosphate, which contains more than half its weight of calcium. It is considered that a mixture of lime and calcium phosphate when applied as a top-dressing is the remedy for dopiness. The use of licks containing calcium salts and bonedust has not yet had a fair trial. In the case of bush-sick coarse pumice soils lime at first has a deleterious effect on the stock pastured on lands recently limed, and in pot experiments lime shows a depressing effect on plant-growth. In field trials there is no appreciable response from the pasture. Club-root and other troubles curable by lime are not generally present on pumice lands, although turnips are benefited, as one would expect, by the addition of lime to the manure sown with the seed. The best fertilizer of all for both turnips and pasture is a mixture of basic slag and superphosphate.

To sum up, all the evidence at present strongly supports the iron-starvation theory for bush sickness, and that it is caused by deficiency of iron obtainable from the pasture, which of course means natural pasture unpurified from its attendant soil contamination. That animals may suffer from bush sickness on certain other soils growing similar iron-deficient pasture, unless they obtain iron by eating the soil, is a possibility; but in these cases the contamination iron is in a more available state than it is in pumice soils, where it occurs as an iron silicate soluble to some extent in the strong fuming hydrochloric acid used in the ash analysis at the laboratory, but insoluble in the weak juices of the ruminant's digestive system. In most normal soils the iron is largely present in a colloidal form or as oxide of iron, and ruminants might gain some advantage from this impurity when the grass was abnormally low in iron.

In the case of Kenya "nakuruitis," which according to Dr. Orr appears to be of the same nature as bush sickness, one would expect that owing to the long periods without rain and with wind in that colony a pasture would be highly contaminated by volcanic dust. If this is so, it has shown no sign of helping the animal over its progressive anæmia. An extensive experiment carried out with cattle in Kenya showed that production in terms of live weight depended upon the amount of iron oxide which the animals received as a lick. Thus the control group lost 33 lb., the group getting low amounts of iron lost 10 lb., the group getting a medium amount of iron gained 55 lb., and the group getting a high amount of iron gained 126 lb. each. Experiments at this laboratory, under glass and under scrim, have shown that in a windy situation it is practically impossible to grow pasture without contamination by atmospheric dust.

The use of iron lick in the bush-sick districts is steadily increasing, the oxide of iron (limonite) from Onekaka, Nelson, obtained by the writer in December, 1924, and specially ground for him, was unfortunately too coarsely ground, and even when mixed with salt the sheep refused to eat it. However, a much softer and finer hydrated oxide (limonite) has subsequently been obtained from the Whangarei deposit, and this is giving satisfactory results with both sheep and cattle when used as a salt lick. It contains twice the amount of iron which the carbonate of iron contains and is much easier to obtain. The Huntly spathic iron ore (impure carbonate of iron) is therefore being

replaced by this alternative choice from New Zealand sources of iron for use in the automatic treatment to combat bush sickness by means of licks.*

Hay and ensilage made with salt will present a greater and more available iron ration to the animal than the pasture it was made from. This generalization also applies to wilted and fermented grass, which is also possibly more palatable and certainly more concentrated than the original pasture. It is not generally realized that the cow's capacity is about 1 cwt. of pasture per day, and if the pasture only contains half the normal amount of iron, as is the case with the worst bush-sick pasture, it is seen that it will be impossible for the cow to overtake the deficiency by eating more pasture.

Experimenters are gradually coming to the conclusion that the amount of iron necessary for the support of animal life is greater than was hitherto thought. From researches at the Rowett Institute it is certain that pigs suffer from deficient amounts of iron in the diet when the quantity and quality of food is apparently sufficient. Rats are said by Levin and others (*Journal of Nutrition*, November, 1931) to require between 0·17 and 0·31 of a milligram of iron per day, a comparatively high amount. Orr ("Importance of Mineral Matter in Nutrition," Trans. High. Ag. Soc., 1923) states that the best guide to the amounts and proportions of minerals required by animals (other than lime and phosphoric acid, which are approximately known) is to be found in the composition in the ash of the milk of the species. The qualification, however, is made that milk is deficient in iron, the young being born with a store of iron in the body. The sheep and the pig are similar in size and in increasing in weight at approximately the same rate when they are growing fastest, and in the amount of iron found in the mothers' milk (Godden, *Journal of State Medicine*, September, 1931). On examining the following tabular matter given in his paper it will be hard to resist the conclusion that if pigs can suffer from lack of iron in the food, especially when grazing, sheep may do so also.

Species.	Number of Days in which Weight of New-born Animal is doubled.	Percentage of Ferric Oxide contained in Milk Ash of Species.
Man	180	0·0006
Horse ..	60	0·0014
Cow	47	0·0021
Goat	22	0·0022
Sheep ..	15	0·0091
Pig	14	0·0089

In conclusion, it may be said that the deficiency diseases (not peculiar to volcanic soils as some suppose) variously known as "bush sickness" in New Zealand, "pining," "vinquish," and "daising" in Scotland, "nakuruitis" in Kenya, "coast disease" in Tasmania, and "salt sick" in Florida, are probably all due to the same cause and curable by the same means as adopted in New Zealand. However this may be, it is certain in the writer's mind that the trouble as it occurs in the coarse pumice soils is preventable by a salt-iron oxide lick and curable by citrate of ammonia and iron.

* This Whangarei oxide of iron is obtainable from N. M. Keane, Fenton St., Rotorua, at 9s. per hundredweight; and the citrate from the Agriculture Department's offices at Rotorua and Tauranga, at 3s. per pound.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

IV. BONE PRODUCTS AND ORGANIC NITROGENOUS MANURES.

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

BONEDUST, dried blood, blood and bone, tankage, and allied types of phospho-nitrogenous manures manufactured from animal residues derived from meat-freezing works, slaughterhouses, and similar establishments for a long time occupied the premier place in the early fertilizer industry. In addition to these, the world's agriculture has in the past consumed large quantities of nitrogenous guanos collected from numerous sources. Fish fertilizers recovered from the fishing industries have also been used by almost all agricultural countries since very early times.

The general utilization of such products to-day, however, is small when compared with the vast consumption of the chemical class of commercial plant-foods, such as superphosphate and sulphate of ammonia. In fact, the development of the manufacture of chemical fertilizers furnishing one or more essential elements of fertility has been largely responsible for the gradually diminishing consumption and importance on the market of the phospho-nitrogenous class of manures mostly of animal origin. Gray, an international authority on commercial fertilizers, has estimated the world's consumption of bone products for agricultural purposes in the year 1928 as 350,000 tons, or under 3 per cent. of the world's total phosphoric acid plant-food consumption.

An interesting and important factor bearing on the relatively diminishing supply of these animal residues for the fertilizer industry lies in their increasing use as ingredients in stock foods and licks. Much of the tankage, for instance, is now diverted to the manufacture of various grades of meat-meal, while bonemeal or boneflour go to supply dietary deficiencies on the farm.

TYPES OF BONE PRODUCTS ON THE MARKET.

BONEMEAL OR BONEDUST.

Fresh dried raw bones consist principally of organic (nitrogenous) matter, fat, and what is chemically termed tricalcium phosphate. This is also styled bone phosphate of lime, being the more established trade term denoting the main fertilizer compound combining the important mineral elements calcium (lime) and phosphorus, which enter into the nutrition of plant and animal life. For the most part, the value of fat-extracted bones as fertilizer is centred on the content of phosphoric acid plant-food present in the form of phosphate of lime, and to a smaller extent on the nitrogenous content. Thus they are purchased on this basis and classed usually as phospho-nitrogenous manures.

In order to render the phosphatic and nitrogenous ingredients more available for plant-life, pulverization of bones to a fine dusty powder is most essential. Even in the earlier days of the fertilizer industry it became customary to boil or steam fresh raw bones before grinding,

in order to deprive them of fat and to leave intact as far as possible the nitrogenous organic matter useful to some extent as plant-food. Occasionally, however, bones are ground without any preliminary treatment for direct application to the land, but the presence of fat is a drawback to the production of a fine meal, tending, as well, to hinder the decomposition of the phosphatic and nitrogenous fertilizing compounds of bone in the soil.

The plant-food content of average high-grade commercial bonedust of fine grist is somewhere near 3 to 4 per cent. of water-insoluble nitrogen (67 lb. to 90 lb. per ton) and 20 to 25 per cent. of water-insoluble phosphoric acid (448 lb. to 560 lb. per ton). With regard to mechanical condition of bone manures sold locally, it may be said that no fineness-of-grinding standard is prescribed under the New Zealand Fertilizers Act, but certain British authorities apparently consider that what is to be sold as bonemeal for fertilizer usage should all pass through a $\frac{1}{8}$-in.-mesh screen. In the absence of any standards prescribing fineness (such as exist in South Africa and Queensland) the term bonedust is often loosely applied to any type of bone material that has been submitted to a grinding-mill.

While on the question of standards it may be mentioned that it is not uncommon for animal organic substances of a fertilizing strength of 6 or more per cent. of nitrogen and 15 per cent. or less of phosphoric acid to be sold as bonedust; but this description is scarcely applicable when the nitrogen content is higher than $4\frac{1}{2}$ per cent. In cases of this kind, the term bone tankage is preferable. If the mixture consisted of dried blood mixed with bone, the description blood and bone would apply. Here again, in the absence of standards under the fertilizer law defining the precise meaning of the terms "bonedust" or "blood and bone," uniformity in regard to descriptive terms in the fertilizer trade is rendered difficult.

STEAMED BONEMEAL.

This material results from steaming bones under high pressure, the object of which, in the first instance, is to remove the superfluous fatty matter valuable for the manufacture of soap, candles, and glycerine, and, in the second instance, to deprive the bones of most of the nitrogenous matter (ossein) useful to gelatine and glue manufacturers. After the residual product is well dried, it is then more easily crushed to a meal or dust. When ground to a very fine powder—that is, if all the material will pass, say, a 50-mesh sieve—the product is termed steamed bone-flour, although it seems that the name is at times indiscriminately applied to steamed bone products of a somewhat coarser texture.

It should be pointed out that while steamed boneflour is still used as a fertilizer, it appears to be steadily growing in favour for supplying the mineral elements lime and phosphorus in well-balanced form as supplements to the rations of cattle and sheep, especially on droughty soils or soils subject to droughty seasons, and on some types of back-country hill pastures where top-dressing with phosphate and lime containing fertilizers is impracticable.

In the course of extracting organic matter from bones the nitrogen content is lowered, but the effect is a proportional increase in the phosphoric-acid content. High-grade samples of steamed bonemeal may contain 1·5 to 3 per cent. of water-insoluble nitrogen (33 lb. to 67 lb.

per ton) and 22 to 27 per cent. (493 lb. to 605 lb. per ton), or even more, of water-insoluble phosphoric acid, which, as already mentioned, is higher when the nitrogen content is low and the reverse when the nitrogen is higher. By reason of the percentage of nitrogen in both steamed bonemeal and boneflour being so small, they are often classed purely as phosphatic rather than as phospho-nitrogenous manures.

The particular merit of fine-gristed steamed bonemeal seems to lie not only in the comparative ease with which it decomposes when harrowed into certain classes of light-textured soil, but also in its power as an excellent drying agent when introduced into mixtures with other fertilizers. Steamed bonemeal prevents caking and hardening, and therefore serves to improve the mechanical condition of fertilizer mixtures for drilling in with seed. With superphosphate, for example, steamed bonemeal or steamed boneflour forms an excellent combination.

The constituents of animal bones vary considerably according to their source and condition, but the following analyses by Thomas Lambert ("Bone Products and Manures") afford some idea of their make-up:—

	Boiled Bones. Per Cent.	Steamed Bones. Per Cent.
Moisture	10·81	10·79
Organic matter*	25·97	22·48
Phosphate of lime†	53·15	57·17
Magnesia and carbonate of lime	6·28	6·89
Oxide of iron	0·27	Trace
Alkaline salts‡	1·07	0·86
Sand (silica)	2·45	1·74
	100·00	100·00
* Containing nitrogen	1·91	1·64
Equal to ammonia	2·31	1·99
† Equal to phosphoric acid	24·30	26·18

‡ Includes traces of alkaline compounds of sodium, fluorine, and chlorine.

Reference may also be made to the fact that bonemeal is at times distinguished in the fertilizer trade according to whether it has been made from steam-treated bones or chemically-treated bones. For instance, the more modern benzine process followed by boiling is resorted to for the extraction of fat and other useful matter from bones in preference to the boiling or steaming process. Apparently the quality of the meal produced by the former method is superior to that produced by the latter.

BONE CHAR.

Bone char, also known as bone charcoal, is the name given to a form of residual charcoal produced when bones are heated in closed iron cylinders. It is employed for refining (decolorizing) sugar and oil, and when used several times its action becomes weakened. Finally, it is sold under names such as "spent char," "char dust," or "animal charcoal dust," to fertilizer-mixers. Limited amounts of both locally produced and imported char dust from some of the older types of sugar-refining plants are employed in the making of commercially mixed fertilizers.

Spent bone char dust is essentially a phosphatic product, containing 27 to 32 per cent. or more of (insoluble in water) phosphoric acid.

Only an insignificant amount of nitrogen, from 1 to 1½ per cent. or less, is present in its composition. In parts of Australia and elsewhere this material is in popular demand for incorporating in mineral stock-licks, being rich in lime phosphate. Its popularity in this direction is also partly due to its charcoal content, considered to be a useful adjunct to licks. In all probability the increasing employment of the limited quantities available for lick-making will eventually preclude its use in the fertilizer trade.

OTHER BONE-PRODUCTS.

Whale-bonemeal or whale-bonedust is made in small quantities from whale-bones obtained from the small whaling-stations of Wekinui (Marlborough) and Whangamumu (North Auckland). Both products have a similar plant-food composition, the average being set out in Table 1.

Bone-ash or calcined bone, consisting of the mineral matter remaining when bones are burnt, was at one time used as a phosphatic fertilizer, principally in Europe and America. It was also used to a small extent in the making of chemical fertilizer, being treated with sulphuric acid to make a form of superphosphate. Bone-ash contains 34 to 38 per cent. of phosphoric acid and appears to be employed overseas to a certain extent in the compounding of mineral stock-licks. A little calcined bone is on sale locally for fertilizing home gardens.

Dissolved bone (vitriolized bone or bone superphosphate) is not retailed in New Zealand, but many years ago was quite popular as a fertilizer, especially in European countries. To-day it is rarely made. The manufacture of dissolved bone is conducted on similar lines to that of superphosphate chemically prepared at much less cost from natural rock phosphate. The reason for treating ground bone or bonemeal with sulphuric acid is to render the bone phosphate into a more available form for crops.

Precipitated bone, a white powder consisting principally of dicalcium or reverted phosphate, is another by-product available from the manufacture of glue from bones. In the United States of America small quantities available are, it seems, now used more for making stock-licks than as fertilizer. It contains about 40 per cent. of water-insoluble phosphoric acid.

IMPORTATIONS OF BONEDUST.

Importations of bonedust into New Zealand were at one time a leading feature. From April, 1910, to March, 1931, roundly 175,000 tons were landed here. Importations, however, have steadily dropped from 4,063 tons in 1921–22 to 795 tons in 1930–31, the total imports for the ten years ended March, 1931, being only 20,503 tons.

Commercial Organic Manures.

DRIED BLOOD.

Dried blood is prepared by steam-heating, drying, and grinding the collected blood of slaughtered animals. The better qualities—in the United States of America, for example—are in some cases used for buttonmaking, while the poorer grades find an outlet in commerce as nitrogenous manures. In Australia and New Zealand latterly there

appears to have been a trend towards the use of dried blood in the preparation of stock-foods and, as already noted, it is quite likely that quantities used for fertilizer purposes will go on gradually diminishing in the future.

Table 1.—Plant-food Composition of Bonedust, Blood, Blood and Bone, and other similar Manures sold in New Zealand.

Designation of Product.	Number of Registered Brands.	Average Percentage of Registered Fertilizing Ingredients.		Range of Percentage of Fertilizing Ingredients.	
		Nitrogen (insoluble in Water).	Phosphoric Acid (insoluble in Water).	Nitrogen (insoluble in Water).	Phosphoric Acid (insoluble in Water).
Bonedust	57	3·5	21·9	2·3 to 4·3	17·2 to 27·2
Dried blood ..	18	12·6	..	12·0 to 14·0	..
Blood and bone manure	66	6·6	11·7	4·7 to 8·5	8·2 to 21·9
Meat and bone manure	2	7·3	11·5	6·5 to 8·0	10·0 to 13·0
Bone tankage ..	1	8·0	10·0	..	..
Bone mixture (tankage)	1	4·6	18·8	..	..
Bone fertilizer (bones chemically treated)	1	3·3	20·5	..	..
Bone-char dust (or animal charcoal dust)	3	..	29·0	..	27·5 to 32·0
Whale-bonemeal (or whale-bonedust)	2	2·9	22·5	..	..
Fish fertilizer ..	2	5·8	12·8	..	..

Remarks on Production, &c.

According to New Zealand factory-production statistics, there were forty meat-freezing and meat-preserving works operating in the Dominion in 1928, 1929, and 1930. These establishments, apart from their main product of meat, treat a number of valuable by-products, including manure. The combined output of manurial by-products for the years stated was as follows :—

Year.	Bonedust and Bone Manure.	Value.	Blood Manure.	Value.	Blood and Bone Manure.	Value.	Other Manure.†	Value.
	Tons.	£	Tons.	£	Tons.	£	Tons.	£
1928 ..	9,696	73,088	*	*	*	*	20,491	135,684
1929 ..	2,657	24,400	*	*	14,013	105,142	15,082	88,942
1930 ..	3,351	32,106	2,707	25,034	8,178	67,585	17,203	104,499

* Included in "Other Manure." † Presumably compound mixtures prepared at these works.

Boiling-down works also utilize animal waste for conversion into manure, &c. The number of such plants in operation during 1928, 1929, and 1930 is given as 36, 34, and 29 respectively, the production of manures alone being as below :—

Year.	Bonedust.	Value.	Blood.	Value.	Other Manure.	Value.
	Tons.	£	Tons.	£	Tons.	£
1928 ..	2,999	24,620	955	7,135	1,660	10,100
1929 ..	2,847	22,814	699	5,202	2,690	17,055
1930 ..	1,691	14,959	469	3,999	1,391	13,672

Blood-meal, a more refined form of dried blood, is a very highly concentrated commercial stock-food, containing 75 per cent. or more of crude protein (equivalent to 12 per cent. or more of nitrogen), used in similar fashion to meat-meal. Fresh blood is not sold as commercial fertilizer, as it contains a high percentage of water and decomposes quickly.

Dried blood appears on the market as a slightly moist dark-reddish meal or powder, with a characteristic but not very pronounced odour. Generally the opinion is that the nitrogen in blood is worth far more per unit than, for instance, the nitrogen in coarse bone-meal. For a long time it was considered the most valuable of all organic nitrogenous manures, but for several years now synthetically prepared urea, a concentrated chemical preparation of German origin containing 46 per cent. (1,030 lb. per ton) of water-soluble nitrogen in organic form, has been on the market at low unit cost.

Though small users cannot employ dried blood in quite the same manner as the quicker-acting water-soluble salts, nitrate of soda and sulphate of ammonia, nevertheless the former has long been found to be suitable when well harrowed into the soil before planting for a large variety of market-garden crops during their growing period, when a steady supply of nitrogenous plant-food is desirable. In addition, there is little chance for the organic nitrogen as supplied in dried blood being carried away through soil-drainage. Mixtures of dried blood with bonedust therefore enjoy a wide measure of favour among market-gardeners, orchardists, hop-growers, &c., as safe, convenient manures. The demand for dried blood as manure has been, of course, principally for blending or mixing with other agents; in this direction it can be used with a wide range of materials.

In quality, dried blood has a range of from 9 to 14 per cent. (202 lb. to 314 lb. per ton) of water-insoluble nitrogen, although, with one exception, in this country the limits are narrower, being 12 to 14 per cent. (269 lb. to 314 lb. per ton) in respect of the several brands registered.

BLOOD AND BONE.

This, strictly speaking, is a mechanical mixture of dried blood and crushed bone; nevertheless, there are on the market several commercial grades of what is loosely styled "blood and bone" made from animal flesh, viscera, &c., from the rendering-plant, in addition to bone or perhaps blood. The designation "tankage" would be much more suitable in cases where the mixture is not entirely composed of dried blood plus bone.

Blood and bone is a "general-purpose" product suitable for almost any type of crop where a manure is desired which will not force growth too quickly. New Zealand brands, containing from 4·2 to 8·5 per cent. of nitrogen and 8·2 to 21·9 per cent. of phosphoric acid, are largely employed for conversion into compound manures—in fact, most of the proprietary mixtures on the local fertilizer market contain varying amounts of blood and bone or animal matter of some description or other. An undoubted advantage attaching to the use of blood and bone lies in the fact that it can be mixed with any class of fertilizer materials without causing reversion of the phosphoric acid or liberation of free ammonia.

TANKAGE.

Tankage is a meal of brownish colour, and, like most animal manures, has a characteristic smell. It comes under the heading of phospho-nitrogenous manures, being manufactured from animal refuse of a heterogeneous character such as blood, bone, intestines, hoofs, horns, meat-scraps, hair, hides, and carcasses of condemned animals, which are efficiently cooked under pressure in large tanks or digesters to remove fatty matter, &c., and at the same time to render the ultimate product more available as plant-food. After the material is removed from the digester it is dried and ground.

In the soil the action of tankage is practically the same as blood and bone, except that its plant-food is generally reckoned to be more slowly available than that of the latter. Tankage is not a standardized product; composition is exceedingly variable, typical analyses indicating a content of 5 to 10 per cent. of water-insoluble nitrogen (112 lb. to 224 lb. per ton) and from 5 to 12 per cent. or thereabouts (112 lb. to 269 lb. per ton) of water-insoluble phosphoric acid. As a conditioner or drier in fertilizer mixtures tankage has a considerable value because of its advantage in tending to correct hygroscopicity of other fertilizers, thus enabling mixtures of good drilling quality to be made.

The description "tankage" covers a fairly wide range of materials from the rendering-plant. Often it has a qualifying term, such as bone tankage (*i.e.*, if it contains a high proportion of bone, but has too much meat to be called bonemeal), meat and bone tankage, animal tankage, garbage tankage, &c. What is known as meat-and-bone meal in England and meat and bone (or even blood and bone) in New Zealand, for instance, is covered by the wider and more general term "tankage" in the United States and Canada.

Digester tankage for stock-feeding purposes must not be confused with fertilizer tankage. In Queensland, for example, the former is held to consist of the residue from animal tissue exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If the residue contains more than 10 per cent. of phosphoric acid it is designated meat-and-bone tankage.

MEAT-MEAL.

Meat-meal, made from meat refuse, cooked, dried, and ground, is sold to a very limited extent as a manure. The plant-food composition is variable; certain high-grade types may yield 10 to 12 per cent. of nitrogen and 1 to 5 per cent. of phosphoric acid.

Various grades of meat-meal, in the form of brown powder with a sweet nutty smell, prepared in modern dry-rendering plants from livers, hearts, and other clean trimmings of stock slaughtered for human consumption, are commanding attention in the field of animal nutrition. Experimental evidence points unmistakably to the suitability and value of these easily digested protein by-products for stock-raising. Most of the high-grade meat-meals on the local market as feeding-stuffs contain 60 to 65 per cent. of protein (9·6 to 10·4 per cent. of nitrogen) together with minor proportions of fat and phosphoric acid.

MEAT AND BONE.

Two brands of meat-and-bone manure—with fertilizing strengths of 6½ per cent. nitrogen and 13 per cent. phosphoric acid, and 8 per cent. nitrogen and 10 per cent. phosphoric acid respectively—are registered for local sale.

Meat-meal and bone-meal for feeding purposes generally contain less protein than meat-meal—typical samples yielding 47 to 52 per cent. (7·5 to 8·3 per cent. of nitrogen) or thereabouts, and in the vicinity of 12 per cent. of phosphoric acid (26·2 per cent. tricalcium phosphate of lime).

FISH FERTILIZER (FISH GUANO, GROUND FISH-SCRAP, FISH TANKAGE).

This is the product rendered from non-edible fish, offals, intestines, heads, tails, bones, and other fish-waste, which is dried and crushed or finely ground after being treated under steam pressure* to remove the fish oil, valuable in other commercial channels but most undesirable in the fertilizer. Fish fertilizer is more particularly valued for its organic nitrogen, which usually ranges between 6 and 10 per cent. The actual phosphoric-acid content may only amount to a percentage of some 4 to 8.

A superior fish-meal is prepared from both edible and suitable classes of non-edible trawler-caught fish and better-class fish-waste, which is sterilized under high pressure. It contains practically none of the objectionable fish oil liable to impart a taste to milk, butter, cheese, eggs, and meat, and commands a good price on the market as poultry or stock food. The building of floating fish-meal factories has received or is receiving attention in various countries.

Fish fertilizer and fish-fertilizer mixtures have been on the New Zealand market in limited quantities for general manurial purposes for some years past. Dressings of this particular class of manure have given highly favourable results in Nelson apple orchards. The quality of fish fertilizer manufactured near Auckland is declared for selling purposes at 6 per cent. of insoluble nitrogen and 12·5 per cent. of water-insoluble phosphoric acid.

WHALE GUANO (WHALE MEAT AND BLOOD, WHALE TANKAGE).

This residual by-product of the whaling industry may contain between 6 and 11 per cent. of nitrogen and from 2 to 4 per cent. of phosphoric acid. It is, however, not sold at present on the local market. The prolific whale life of the waters in our Ross Dependency—of late years exploited on a very large scale for whale oil by Norwegian interests—may ultimately afford an auxiliary source of useful organic by-products for New Zealand's agriculture.

SEA-BIRD GUANO.

Certain forms of guano are a rich source of organic nitrogen, but it should be observed that the term "guano" is not always confined to the excrementitious deposits and remains of birds living on fish and

* The benzine process is also adopted for extraction of fish oil, &c. Occasionally fish-scrap is treated with sulphuric acid for rendering fertilizer ingredients more available.

other marine life. In the fertilizer trade overseas it is customary to apply some qualifying term or adjective to the word guano to define certain types of organic fertilizer, such as phospho-guano, whale guano, fish guano, animal guano, Peruvian guano, and bat guano. Generally, the designation "guano" in itself is confined to nitrogenous sea-bird or bat guano from natural deposits containing, say, 4 per cent. or more of nitrogen, 11 per cent. or more of phosphoric acid, and 1 to 2 per cent. of potash. Phosphatic guano is the term applied to well-leached guano, containing in the vicinity of 1 to 3 per cent. of water-insoluble nitrogen and from 12 per cent. upwards of water-insoluble phosphoric acid. In the case of material containing, say, 12 to 40 per cent. of insoluble phosphoric acid and less than 1 per cent. of insoluble nitrogen, the designation "rock phosphate" is more appropriate.

As an all-round manure, high-quality unadulterated nitrogenous sea-bird guano was at one period probably the most popular material on the market, but its present use is restricted on account of the high price and the difficulty of obtaining regular supplies of the genuine material. The composition of sea-bird guano is exceedingly variable, being dependent upon the climate of the region in which it is found. In an exceptionally dry district this dung will contain a good proportion of nitrogen, potash, and even a little of its phosphoric acid in water-soluble form; but in a locality where rains occur, the nitrogen and potash may almost all be leached out, leaving residues containing insoluble (tricalcium) phosphate. Here the term "phosphatic guano" or "rock phosphate" is preferable to the term "guano." In a guano which has not been subjected to leaching action, the nitrogen exists in small proportions as ammoniacal salts, nitrates, and salts of uric and other organic acids. In consequence of possessing this nitrogenous matter, on which the main value is placed, true guano is classed as a nitrogenous fertilizer.

The best-known deposits of decomposed sea-bird excreta are found on numerous barren, rainless islands off the coast of Peru, the material collected from this source being sold under the designation of "genuine Peruvian guano." Another well-known source furnishing supplies of high-grade nitrogenous guano is the Ichaboen islands off the coast of Africa. The best quality Peruvian raw bird-guano contains as high as 13 per cent. or even more of nitrogen and about 11 or 12 per cent. of phosphoric acid, mostly water-insoluble; a little potash is also present.

Special grades of guano—Peruvian, for example—are now and then treated with sulphuric acid with the object of preventing volatile ammonia (nitrogen) from escaping, and at the same time to render the bulk of the phosphoric acid in the guano soluble in water. Guano so treated is known as "dissolved guano," and typical samples may yield 9 to 10 per cent. of phosphoric acid, in addition to $4\frac{1}{2}$ to 7 per cent. or more or nitrogen and 1 to 2 per cent. of potash. Imported material sold under the designations of Peruvian guano and dissolved guano respectively are sold in small quantities by New Zealand merchants.

Miscellaneous Organic Waste Products.

A considerable variety of trade-waste materials, mostly of animal origin, are available in fairly large quantities in a number of overseas countries. Such materials include hoof and horn, leather waste, wool

waste, shoddy, rabbit-fur waste, felt, house garbage, sewage sludge, &c. These all contain varying proportions of nitrogen in organic form and in some cases appreciable amounts of phosphoric acid. Unless subjected to some such treatment as steaming under pressure, drying, and grinding to increase the availability or fertilizing power of their nitrogenous matter, &c., materials of this class, although rich in nitrogen, may often be so resistant in their natural state to the agencies of decomposition that they will lie inert in the soil for years. As a matter of fact, the availability of all organic manures is more or less dependent upon the nature of the soil and the character of the season.

The cost of converting waste matter into merchantable products suitable, say, for the makers of horticultural and market-garden manures is often excessive. In fact, the utilization of many forms of industrial waste materials for the manufacture or conditioning of commercial fertilizers rests mainly on the question of costs. If the finished article can be produced at a reasonable price and is of sufficiently good quality to repay the cost of short-distance transportation, there should be no need for waste of organic manure materials of any description.

Undoubtedly slow-acting organic manures have under special conditions of market-garden and horticultural practice some value for soil-improvement, even though they be bulky and inferior in quality and action to the standard organic manures such as dried blood. It is, of course, well recognized that to compensate for the substitution of slower-acting manures of low analysis larger applications are necessary.

Use of the Terms "Nitrogen" and "Ammonia."

With the growing use of chemical language in fertilizer terminology, there is always liable to be some confusion as regards the various methods employed in stating the plant-food value of fertilizers. A notable example is to be seen in the use of the terms "nitrogen" and "ammonia" relative to the class of fertilizer here under discussion.

The term nitrogen (symbolized by the letter N) denotes an element universally accepted as one of the plant-food essentials. Under the Fertilizers Act its percentage in any grade of commercial fertilizer must be disclosed both in the registration statement filed with the Department of Agriculture and in the invoice certificate issued to the fertilizer purchaser.

Ammonia (represented by the chemical formula NH_3), a compound combining one atom of nitrogen with three atoms of hydrogen, is often employed in advertising-matter as a means of expressing the nitrogenous plant-food of a fertilizer. This method of statement appears to be favoured by certain advertisers because any percentage of nitrogen expressed in terms of ammonia gives a higher figure than if expressed as nitrogen alone. For example, 17 per cent. of ammonia is equivalent of 14 per cent. of nitrogen.

To convert ammonia into its equivalent of nitrogen the percentage of ammonia may be multiplied by 14 and the product divided by 17; conversely, to express nitrogen in terms of ammonia the percentage of nitrogen is multiplied by 17 and the product divided by 14. Following is an example: A certain brand of blood-and-bone manure is advertised for sale to contain 5 per cent. of ammonia. Expressed in terms of nitrogen the percentage is 4·1, found by the following calculation:

$(5 \times 14) \div 17 = 4{\cdot}1$ per cent. Conversely, if the blood and bone is guaranteed to contain 4·1 per cent. of nitrogen, it contains the equivalent of 5 per cent. of ammonia. In other words, 4·1 lb. of nitrogen yield on decomposition in the soil 5 lb. of ammonia. As an alternative, ammonia may be converted into nitrogen by multiplying by the factor 0·8225, and nitrogen into ammonia by multiplying by the factor 1·214.

A useful range of percentages of ammonia and their equivalents in terms of nitrogen is given in Table 2. Similar tables for converting percentages of tricalcium phosphate into their equivalents of phosphoric acid were published in the *Journal* for May and July, 1931, in the articles on basic slag and superphosphate respectively.

Table 2.—Equivalents of Ammonia in Terms of Nitrogen.

Percentage of Ammonia.	Equivalent Percentage of Nitrogen.	Percentage of Ammonia.	Equivalent Percentage of Nitrogen.
1	0·8	16	13·2
2	1·6	17	14·0
3	2·5	18	14·8
4	3·3	19	15·6
5	4·1	20	16·5
6	4·9	21	17·3
7	5·8	22	18·1
8	6·6	23	18·9
9	7·4	24	19·7
10	8·2	25	20·6
11	9·0	26	21·4
12	9·9	27	22·2
13	10·7	28	23·0
14	11·5	29	23·9
15	12·3	30	24·7

(Series to be continued.)

PARASITES FOR CONTROL OF CABBAGE BUTTERFLY.

In the *Journal* for June, 1931, was published an illustrated article on "Pieris rapae: A recently introduced Cabbage Pest," by Mr. J. Muggeridge, Entomologist, Plant Research Station, giving the life-history of the insect, methods of control, &c. There is little doubt that Pieris rapae, which was first noticed at Napier, has now become well established in Hawke's Bay, and it appears to be steadily spreading in the North Island. Specimens have lately been received by the Entomologist for identification from Te Puke, Waiotapu, and Dannevirke. In his article Mr. Muggeridge mentioned *Apanteles glomeratus* as one of the most important insect parasites of Pieris rapae. In response to a request, the Imperial Institute of Entomology, London, has now forwarded to the Plant Research Station some 3,000 puparia of *A. glomeratus*, and this material will be used for breeding up supplies of the parasite for distribution. There are good reasons for believing that, once established, this parasite will considerably reduce the depredations of the pest. Apart from biological control, however, Pieris rapae may be controlled by sprays, some particulars of which were given in the article referred to.

CORTICIUM DISEASE OF POTATOES.

IV. CONTROL TREATMENTS SHOWN TO BE NOT WARRANTED UNDER NEW ZEALAND CONDITIONS.

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WITHIN the last few years several workers have questioned the value of seed-treatments for the control of corticium disease of potatoes. White (1927) gave an account of co-operative experiments on control of corticium carried out in several parts of the United States of America during the 1926 season. In four of the States the percentage of clean sprouts in the various plots was determined, and sprout-injury in Florida was found to be very low. No general correlation could be established between increased yield and a high percentage of clean sprouts. Clayton (1929) after four years' work on corticium control came to the conclusion that the prevalence of soil-infection on Long Island, New York, made seed-treatment scarcely profitable. Treatments with mercury compounds gave an increased yield of 2 per cent., which did not warrant seed-treatment. Gratz (1930) recorded that corticium was more evident in Maine than in Florida, where the incidence of stem cankers is comparatively low. In a later paper of the same year he gives an account of six years' experiments in the Hastings potato belt, Florida, on the control of corticium. The results of these experiments indicate that seed-treatment is unwarranted, for, while few significant increases in yield were obtained, numerous cases of actual reduction were recorded as a result of treatment. Schlumberger (1930) states that in 1930 corticium caused little reduction in yield of potato crops in Germany, and he considers that exaggerated importance is attached to the pitting injury of the tubers caused by this fungus. In a later paper (1931) he says that potatoes should not be rejected from certification on account of corticium unless the bulk of the tubers are heavily infected.

EFFECT OF CORTICIUM ON YIELD IN NEW ZEALAND.

A series of trials was carried out at the Plant Research Station during the 1930–31 season for the purpose of testing various treatments and to obtain some idea as to the effect of corticium on yield. The treatments were carried out fifteen weeks before planting. The hundred tubers of each treatment were planted in ten replications of ten tubers per plot. Results were as follows:—

Table 1.

Type of Sets.	Number of Sets.	Strength of Acidulated Corrosive Sublimate.	Length of Soak in Minutes.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Seed, corticium-infected ..	100	..	..	73	8·5
Seed, picked clean ..	300	..	..	2·3	7·7
Seed, corticium-infected ..	100	1–1,000*	120	13	6·4
,, ..	100	1–6·6–1,000	90	12	7·9
,, ..	100	1–10–500	5	12	8·3

* This treatment is the old standard treatment—1 part corrosive sublimate and 1,000 parts water—while all the others are acidulated, the amount of acid present being denoted thus: 1–6·6–1,000=1 part corrosive sublimate, 6·6 parts hydrochloric acid, and 1,000 parts water.

Table 1—continued.

Type of Sets.	Mumber of Sets.	Strength of Acidulated Corrosive Sublimate.	Length of Soak in Minutes.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Seed corticium-infected ..	100	1–10–500	20	9	8·6
,, ..	100	1–10–500	90	5	7·2
Seed, picked clean ..	100	1–6·6–1,000	90	2	9·8
Cut table, corticium-infected	200	..	..	53	5·9
,, ,,	100	1–6·6–600	60	7	7·5
,, ,,	100	1–6·6–500	60	10	8·4
,, ,,	100	1–6·6–800	90	13	6·7
,, ,,	100	1–10–700	60	7	6·5

Of the nine treatments tested on corticium-infected potatoes only two produced a significant increase in yield, while one actually produced a significant reduction. A comparison of the picked clean seed and the corticium-infected seed shows that the infected seed yielded slightly better than the clean, although the difference was not significant. From the consideration of these results it seems that corticium is having but little effect on yield.

Stimulating Effect of Organic Mercury Compounds on the Growth of Potatoes.

Certain chemicals have a stimulating effect on the growth of potato tubers, as is shown by the work of Denny (1926) on the breaking of their dormant period. From the results of one year's experiments here with certain organic mercury compounds it appears that, although they were not efficient in controlling corticium, they did have a stimulating effect on the growth of the plants. The organic mercury compounds in question were Semesan Bel, Cal-K, and No. 664, all products of E.I. du Pont de Nemours and Co. The results are shown graphically in Fig. 2, in which the rates of germination in the treated and untreated lines are compared.

The treatments also had a decided influence on the yields, as may be seen from Table 2.

Table 2.

Treatment.	Strength.	Length of Dip.	Number of Sets.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Control	..	..	125	70	9·2
Acid. Corrosive Sublimate	1–6·6–1,000	90 minutes ..	300	11	8·2
Cal-K	1–40 ..	Instantaneous	100	25	10·2
Semesan Bel ..	Paste ..	,,	100	71	10·9
No. 664	1–68 ..	1 minute ..	100	34	11·0

The organic-mercury treatments have here had a definite effect on germination and yield. The increased vigour of the treated plants may be further seen from Fig. 1, which shows a section of the crop thirty-two days after planting. The poor results obtained from the acidulated-corrosive-sublimate treatment was due to induced dormancy brought about by late treatment.

FIG. 1. INCREASED VIGOUR OF PLANTS PRODUCED BY ORGANIC MERCURY TREATMENTS.

Rows 1 and 7 untreated; rows 2 and 6 treated with acidulated corrosive sublimate; row 3 treated with No. 664; row 4 treated with Semesan Bel; row 5 treated with Cal-K.

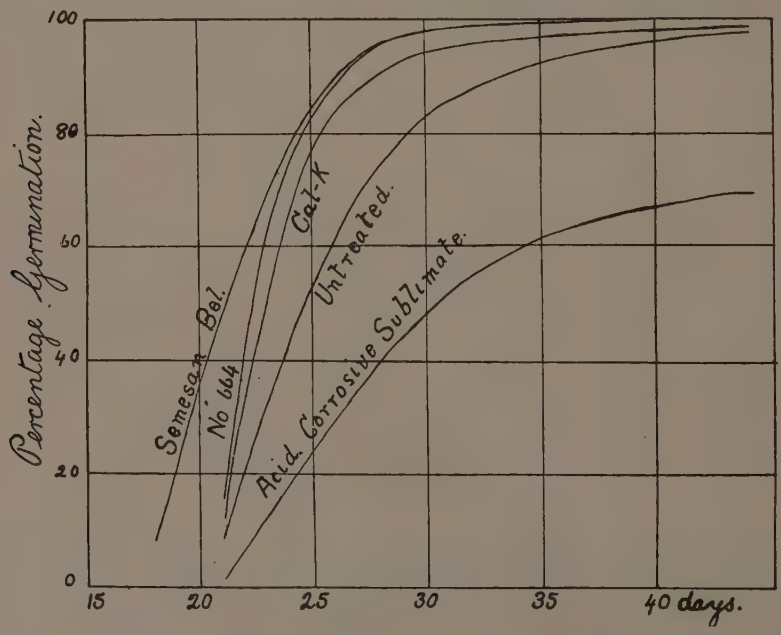

FIG. 2. GRAPH SHOWING EFFECT OF ORGANIC MERCURY TREATMENTS.

Seed-treatment Considerations.

(1) The effect of corticium on the yield of potato crops in New Zealand is doubtful, and from the experimental evidence available it seems probable that no great reduction is caused by this disease. Corticium has not been observed to produce much pitting, cracking, or disfiguring of potato tubers. The only injury to the tubers themselves is a slightly rough appearance produced by the presence of the black sclerotia on the surface.

(2) Treatments for the control of corticium are liable to injure the potato tubers by causing pitting and bringing about an induced dormancy. Unless the treatments are carried out while the tubers are dormant they may have a detrimental effect on the yield.

(3) It has not been possible to find a treatment which will give complete control of corticium. In all, three organic-mercury treatments, the standard corrosive-sublimate treatment, and nine different acidulated-corrosive-sublimate treatments have been tested. Of these the acidulated-corrosive-sublimate treatments were the most satisfactory in controlling the disease, and the best treatment—1–10–500 acidulated corrosive sublimate, 1½-hour soak—reduced the infection from 73 per cent. to 5 per cent. This treatment, however, was so severe on the tubers that it brought about a reduction in yield, although the seed-tubers had been treated while they were dormant.

(4) If an infected line of potatoes is planted in land free from corticium the organism spreads into the soil and may infect subsequent potato crops. An experiment carried out in the South Island showed that corticium was present in the soil four years after the last crop of potatoes had been grown. At the end of this period the disease still persisted to such an extent that treated and untreated seed grown in this land showed the same percentage of infected tubers at digging-time. It is obvious, therefore, that there is no advantage in attempting to produce a line free from corticium unless one is intending to plant the seed in clean soil.

(5) Corticium spreads readily from plant to plant in the row, so that the percentage of disease within a line increases. Experiments have shown that when the sets are planted 16 in. apart the extent of the spread is 23 per cent. of the infected plants. In the field the sets are usually planted closer than this, so the spread would probably be greater. Under the circumstances, to keep a line reasonably free from corticium it would be necessary to treat every second or third year.

(6) Under certain conditions of storage corticium spreads rapidly from tuber to tuber, so that a line which at digging may have had a small percentage of infection may be heavily infected when the tubers are planted in the following season. Since even the produce of treated potatoes will show a certain amount of infection, there is a danger of the effect of treatment being entirely lost within one season.

A consideration of these facts indicates that the benefits resulting from seed-treatment are doubtful, that the treatment itself is risky and may have a detrimental effect on the yield, and that the chances of keeping a line reasonably clean without treatment every second or third year are small. Under these conditions treatment of seed potatoes by the ordinary potato-grower is not warranted.

Treatment for Special Purposes.

Although treatment is not recommended for general use among potato-growers, it is realized that some farmers may wish to have corticium-free potatoes for show purposes. Since no treatment could be found which gave complete control, it is suggested that any farmer wishing to obtain clean potatoes should select, from his line of seed, tubers as free as possible from sclerotia, and then treat these by the following method:—

Solution: 1 oz. corrosive sublimate, ⅓ pint concentrated commercial hydrochloric acid, 6 gallons water. Time of immersion: 1½ hours. To make up the solution, add the corrosive sublimate to the hydrochloric acid, in which it dissolves readily. When it is all dissolved, the solution is added to the water. The treatment should be carried out in a wooden or earthenware receptacle, since both corrosive sublimate and the acid attack metals, and the acid attacks concrete.

To make sure that the treatment will not injure the seed, it should be carried out before the tubers show any signs of sprouting, preferably four months or more before planting. The potatoes should be well dried before storing. If it is already late in the season, and the tubers have sprouted, injury which will follow late treatment may be lessened by treating immediately before planting.

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(Note.—The foregoing article concludes this series.)

Check Testing at Dairy Factories.—This work is referred to in the annual report of the Dairy Division for 1930–31, as follows: "The check testing at dairy factories of suppliers' samples of milk and cream for butterfat content has been considerably extended during the year, as, in addition to the two officers specially detailed for this work, the Dairy Instructors have assisted as opportunity offered. In all, 550 visits were made to dairy companies for this purpose. Dairy companies are keen to carry out the testing accurately and efficiently. Very few samples of milk and cream now come forward to the Division for testing as a check against that of the factory test, which is an indication that suppliers are satisfied that the factory testing is being carried out accurately."

HOST RANGE OF SCLEROTINIA SCLEROTIORUM IN NEW ZEALAND.

R. M. BRIEN, Mycological Laboratory, Plant Research Station, Palmerston North.

IN New Zealand the fungus Sclerotinia sclerotiorum occurs on a wider range of plants than any other species. It will be seen from the accompanying table that the host-range in this country comprises twelve families and thirty-nine species. The fungus attacks the seed, stems, fruit, or bulbs of the tabulated species, upon which it produces round black sclerotia of variable size.

Table of Hosts and Parts affected.

Host.		Parts affected.
Botanical Name.	Common Name.	
Ranunculaceae—*Delphinium ajacis*	Larkspur	Stem.
Cruciferae—		
Brassica campestris ..	Turnip	Bulb.
Brassica napo-brassica ..	Swede	Seed, bulb, and stem.
Brassica napus	Rape	Stem.
Brassica nigra	Mustard	Stem.
Brassica oleracea var. *Ramosa*	Chou moellier ..	Stem.
Cardamine heterophylla ..	Bitter cress	Stem.
Chieranthus chieri	Wallflower	Stem.
Raphanus sativus	Radish	Bulb.
Rosaceae—		
Pyrus communis	Pear	Fruit in store.
Pyrus malus	Apple	Fruit in store.
Leguminosae—		
Glycine soja	Soy-bean	Stem.
Lupinus angustifolius ..	Blue lupin	Pods and stem.
Medicago sativa	Lucerne (alfalfa) ..	Stem.
Phaseolus vulgaris	French bean ..	Stem.
Pisum sativum	Garden pea	Pods and stem.
Vicia faba	Broad bean ..	Stem.
Rutaceae—		
Citrus aurantium	Orange	Fruit.
Citrus medica var. *limonum*	Lemon	Stem and fruit.
Malvaceae—*Lavatera arborea* ..	Tree-mallow ..	Stem.
Passifloraceae—*Passiflora edulis*	Passion-vine ..	Stem.
Umbelliferae—		
Daucus carota	Carrot	Bulb.
Pastinaca sativa	Parsnip	Bulb.
Solanaceae—		
Lycopersicum esculentum ..	Tomato	Fruit and stem.
Nicotiana tabacum ..	Tobacco	Stem.
Solanum tuberosum ..	Potato	Stem.
Scrophulariaceae — *Antirrhinum majus*	Antirrhinum ..	Stem.
Cucurbitaceae—		
Citrullus vulgaris	Water melon ..	Stem and fruit.
Cucumis cantalupensis ..	Rock melon ..	Stem and fruit.
Cucumis sativus	Cucumber	Stem and fruit.
Cucurbita pepo.	Pumpkin	Stem and fruit.
Cucurbita pepo. var. *Blighia sapida*	Marrow	Stem and fruit.

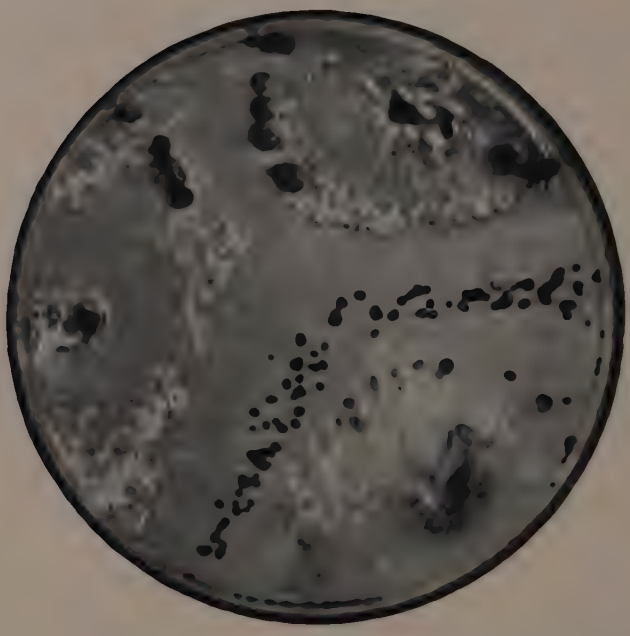

FIG. I. TWO TYPES OF SCLEROTIA GROWING FROM LUPIN SEED.

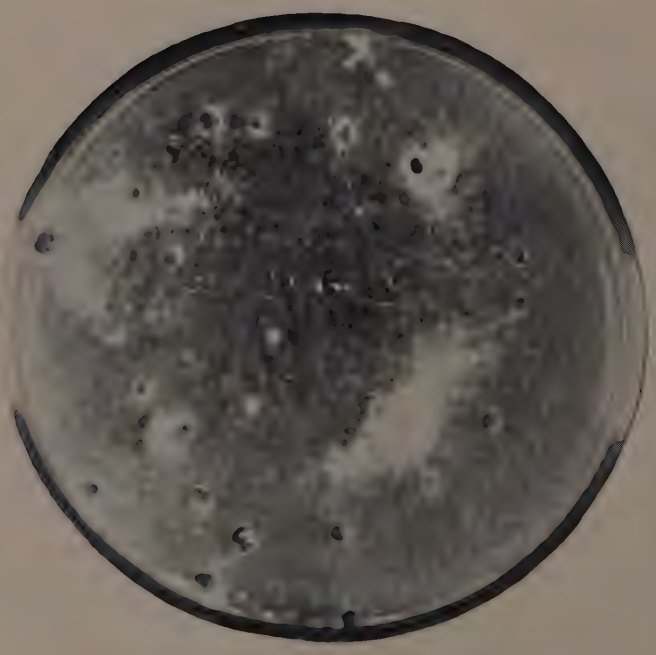

FIG. 2. THE FUNGUS GROWING FROM SWEDE SEED.

Table of Hosts and Parts affected.—continued.

Host.		Parts affected.
Botanical Name.	Common Name.	
Compositae—		
Circium arvense	Californian thistle ..	Stem.
Cnicus lanceolatus	Spear or Scotch thistle	Stem.
Helianthus tuberosum ..	Jerusalem artichoke	Tuber and stem.
Lactuca sativa	Lettuce	Crown and leaves.
Silybum marianum ..	Milk thistle.. ..	Stem.
Sonchus oleraceus	Sow thistle ..	Stem.
Zinnia elegans	Zinnia	Inflorescence, stem.

Recently, when testing a commercial line of English swede seed for the presence of dry-rot (*Phoma lingam*) several greyish-white discoloured seeds were observed in the sample. These were planted on prune dextrose agar, and typical colonies of Sclerotinia sclerotiorum secured. This illustrates the manner in which the fungus has spread to the swede crops in the Dominion, where in recent years it has proved a troublesome disease.

DELAYED GERMINATION IN CEREALS.

ALTHOUGH the seeds of cereals are commonly regarded as being easy of germination, yet samples of wheat, oats, and barley are frequently found which do not give complete germination within the standard testing-period of twelve days. Almost invariably such samples are from newly harvested lines, and so far as New Zealand is concerned the trouble is confined almost wholly to oats and barley. This delay may be due to either heating in the stack or to incomplete maturity. A heated sample is, superficially, fairly obvious, but the failure to germinate of a clean well-stored grain has frequently caused much speculation.

Samples of newly threshed oats and barley were received last year which showed only a very low growth-percentage—frequently under 10 per cent. Yet if this seed was held for two to six weeks it gained the ability to germinate normally. The phenomenon is due to the fact that, although the seed is to all appearance ripe at the time of harvest, it is not what is termed "germinating ripe," and some time has to elapse before the after-ripening processes are completed. With special laboratory treatment, the after-ripening process in wheat and barley can be brought to completion in a few days, when the seed will germinate normally; but in the case of oats the samples have to dry out without assistance before a normal germination can be obtained. The field germination of such samples is usually very erratic—in some cases the growth percentage is higher than the artificial one, and in others very much lower, in some cases nil.

Care should be taken, therefore, in the sowing of newly harvested cereals, and if the laboratory growth is low the line should be stored under dry airy conditions for at least one month.

—*N. R. Foy, Seed Analyst, Plant Research Station.*

USE OF THE HYGROMETER IN CURING TOBACCO-LEAF.

C. Lowe, Instructor in Tobacco Culture, Department of Agriculture.

The hygrometer, or wet and dry thermometer, can be of great assistance to the intelligent grower in the process of flue-barn curing of yellow tobacco-leaf. The use of a hygrometer is to ascertain the amount of moisture contained in the air. To understand the working of the instrument certain natural laws must be recognized: (1) In the process of evaporation or drying-up a certain amount of heat is consumed or used; (2) saturated air can hold no more moisture, therefore evaporation in an enclosed space ceases; (3) dry air absorbs moisture from wet objects more or less quickly, according to the temperature above freezing-point.

In order to test a hygrometer place both bulbs in cold water at 40° F., when they should read the same. Next place them in warm water at 100°, and then in hot water at 150°, when again each should read the same. If the instrument does not record exactly on both bulbs it is useless. Assuming the instrument to be correct, fill the sump with water and adjust the wick. Completely cover the mercury of the wet bulb. Expose the wet and dry bulb to the sunshine outside at, say, 85° on the dry bulb. By the time the water in the sump has reached the same heat the evaporation of moisture from the wick covering the wet bulb will be about 15° lower than the dry bulb; fifteen degrees of the sun's heat is being used to dry up the wick; the air is dry and able to absorb it.

Now for the adaptation of the hygrometer to the process of tobacco-curing. After the barn has been loaded with its correct quantity of ripe tobacco-leaf the hygrometer should be hung in a central spot among the leaves, where it can be easily examined, but not directly over the hot flue-pipe. The barn should be shut tight so as to hold all the moisture given off by the wilting leaves. The hygrometer reading, after the fire has been going about two hours and a temperatur of 80° has been reached, should be 80° dry and 77° wet, and this difference of three degrees should be kept throughout the whole of the yellowing process of thirty-six to fifty hours as the case may be.

When the hygrometer registers more than 4° F., difference between dry and wet bulbs it shows that the barn is drying out too quickly, as in the case of a leaky building, and artificial moisture must be added, such as wetting the walls and floor. Do not put water on the flue-pipes, as the steam formed is 212° at contact and is liable to scald the leaves as the steam rises into them.

For the tobacco to have turned yellow a certain quantity of moisture must have left the leaf, but the process is very slow, and the leaves have been more cooked yellow than dried out. During the period of fixing of colour, between 95° and 115°, the use of the record indicated on the hygrometer is most important to the curer. If the tobacco is dried out too quickly—say, with a difference of 15°—it will blotch, rupture the cells or fabric of the leaves, and go patchy brown. If, on the other hand, it is dried out too slowly and moisture allowed to settle

Flue-barn Chart for Curing of Yellow Leaf Tobacco.

Day.	Time.	Hours.	Temperature.	Remarks.
	p.m.		Degrees F.	
Monday ..	9		80	Ventilators shut tight.
	10		90	
	11		90	
	12		90	
	a.m.			
Tuesday ..	1	4	90	Hygrometer wet bulb 3° to 4° below dry.
	2		90	
	3		90	
	4		90	
	5	8	90	
	6		90	
	7		90	
	8		90	
	9	12	90	
	10		90	
	11		90	
	12		90	
	p.m.			
	1	16	90	
	2		90	
	3		90	
	4		90	
	5	20	90	
	6		90	
	7		90	
	8		90	
	9	24	90	
	10		90	
	11		90	
	12		90	Form steam-water on flue.
	a.m.			
Wednesday ..	1	28	90	
	2		90	
	3		90	
	4		90	
	5	32	90	
	6		90	
	7		90	
	8		90	
	9	36	90	Leaf begins to yellow at tips and edges.
	10	37	91	
	11	38	92	
	12	39	94	
	p.m.			
	1	40	96	Yellow spreads to midrib.
	2	41	98	
	3	42	100	Leaf yellow.
	4	43	102	
	5	44	103	
	6	45	104	Wet bulb 6° to 7° below dry.
	7	46	105	
	8	47	105	
	9	48	110	Midrib yellow.
	10	49	110	Fix colour.
	11	50	110	Ventilator open 2 in.
	12	51	110	

Flue-barn Chart for Curing of Yellow Leaf Tobacco—continued.

Day.	Time.	Hours.	Temperature.	Remarks.
	a.m.		Degrees F.	
Thursday ..	1	52	115	Half open ventilators.
	2	53	115	
	3	54	115	
	4	55	115	
	5	56	115	
	6	57	115	
	7	58	115	
	8	59	115	
	9	60	115	Full open ventilators. Tips of
	10	61	115	leaf curl upwards.
	11	62	115	
	12	63	115	
	p.m.			
	1	64	115	
	2	65	115	
	3	66	120	
	4	67	120	Sides of leaf curl inwards.
	5	68	125	
	6	69	125	
	7	70	125	Blade of leaf should be dry.
	8	71	125	
	9	72	130	Remove hygrometer.
	10	73	130	
	11	74	130	
	12	75	130	
	a.m.			
Friday ..	1	76	135	Veins of leaf should be dry.
	2	77	135	
	3	78	135	
	4	79	135	
	5	80	135	Reduce vents.
	6	81	140	
	7	82	145	Half vents.
	8	83	150	
	9	84	155	Almost close ventilators.
	10	85	160	
	11			
	12			
	p.m.			
	1	88		
	2			
	3			
	4			
	5	92	..	Midrib dry.
	6			
	7			
	8			
	9	96		
	10			
	11			
	12			
	a.m.			
Saturday ..	1	100	170	Stalks should be dry.
	2			
	3			
	4	104		

on the face of the leaf (this often happens in the corners) the leaf will sponge at a temperature of 105°, with the hygrometer showing a difference of only 3° below for the wet bulb. It should show a difference of 6° to 7° at that temperature, and the difference be continued right up to 115°.

After the blades of the leaf are dry at, say, seventy-two hours, at a temperature of 130°, the hygrometer should be taken out of the barn, as it is of no further use when killing out the leaf, and very often has been burst.

The accompanying chart has been used by many tobacco-growers. It should be borne in mind that the chart is adapted for a barn 16 ft. by 16 ft. by 20 ft. inside, filled with eight tiers of eighty-eight sticks, or about seven hundred sticks of first-picking ripe lower-leaf lugs. The times and temperatures must be varied as the season advances and leaves are gathered higher up. The top leaves picked, say, at the end of March when nights are comparatively cold, would need a longer time and lower temperatures for the first yellowing stage.

Consistent use of the hygrometer for recording the humidity of the tobacco-barn during the early stages of yellow-tobacco curing will give the grower a confidence in his work. It removes the danger of guess-work at a very critical period, especially in changeable showery weather when atmospheric conditions vary from wet to dry in the course of a few hours.

OCCURRENCE OF SUN-SCALD ON APPLES IN HAWKE'S BAY.

SEVERE sun-scald on apples occurred throughout the orchards in Hawke's Bay during a period of high temperatures and still air on the 23rd and 24th of January this year. During this period many heavily laden branches fell down suddenly where unsupported, allowing the hitherto shaded surfaces of fruits to become suddenly exposed to the sun. A noticeable feature of damage was the increase in severity on those horizontal branches nearer the ground, where the movement of the air was less, whereas higher in the trees and on uprights the damage was hardly appreciable. The damage was more general, and more severe in character in very sheltered situations, and decreased on trees which were more in the open. It appears that where there is air movement, even though moderate, sun-scald does not occur. Trees which were adequately braced and had fruiting arms supported suffered but slightly in comparison with others not protected in this way.

The bracing of fruit-trees and giving additional support to heavily laden branches is indicated as a method of minimizing fruit losses through sun-scald. The practice in itself is very desirable, as it provides protection against breakages and makes for the easier working of the orchard where large trees are involved. It becomes even more desirable when, by this practice, protection against sun-scald may be secured.

—N. J. Adamson, Orchard Instructor, Hastings.

Eradication of Chewings Fescue.—A Marton farmer writes to the Editor regarding a method successfully used by him for getting rid of Chewings fescue. He ploughs about October, burying the fescue with skim skeiths; then cultivates in the ordinary way, and sows rape or swedes in December. The fescue is found to be all rotted by the following spring and acts as manure. The main point is the use of the skim skeiths (coulters) in the ploughing when the fescue sward is first broken up.

SEASONAL NOTES.

THE FARM.

Reviewing the Feed Position.

As the first step to the making of plans for future work many farmers will find it very useful at this season to review their position in respect to feed. Generally the position will give rise to anxiety rather than to satisfaction. Because of the prevailing unfavourable season stocks of hay and silage are much lower than they would have been had the season been a normal one. This is reflected in the fact that hay is already being sought at prices exceptionally high relative to the current prices of farm produce. In addition, the unfavourable season also leaves the supplementary fodder-crop position less satisfactory than it usually is. It will probably prove advisable to consume in late summer reserves of feed, including silage, which normally would serve for the winter period.

Linked with this unfavourable feed position is generally a weakened financial standing, which naturally makes farmers anxious to spend every penny of outlay to the best advantage. It may be said with certainty that some, in their eagerness to exercise economy fully, are so drastically reducing expenditure as to be really practising harmful parsimony or false economy, which at times may prove very far-reaching and enduring in its undesirable influence. It is not always advisable to meet a period of low prices by indiscriminately drawing tight the purse-strings. Expenditure, indeed, provided it is judicious, is at times the essential accompaniment of efficiency. Phosphatic top-dressing, a matter of seasonable and vital importance, aptly illustrates this.

Autumn Top-dressing with Phosphates.

Of the several measures which may be employed to assist in relieving the position, top-dressing with phosphates, especially superphosphate and, in suitable districts, basic slag, well deserve pride of place. Two main facts relative to phosphatic top-dressing are sufficient to indicate what course should be taken. In the first place, over wide areas the profit from such top-dressing was so great, on the old scale of prices for farm-produce, that there still is an attractive profit in the returns at the present prices. Indeed, at times it is only by taking advantage of the profits available by means of phosphating that farming can be made to pay at all. In the second place, not only have recent years been marked by a swing in popular favour to the practice of autumn application of phosphates in contradistinction to spring application, but critical examination of the position has shown that this swing is essentially sound. Direct financial considerations may lead some to incline to spring top-dressing; spring application may mean escaping from the payment of about four months interest on the cost of the manure; it may mean that no payments for fertilizer have to be made until well on in the producing season, in which the greatest amount of benefit from the manure is obtained. These considerations may seem sufficient to justify spring top-dressing until they are weighed against the advantages which usually are attached to autumn top-dressing with phosphates.

Quite an important advantage of February to April top-dressing is that, prior to the dormant winter period, it usually brings about an appreciable increase in valuable growth. If the top-dressing is done at an early enough date, some of this increase may be particularly useful this year in maintaining dairy production towards the end of the season. Certainly in view of the prospective winter scarcity of feed, any additional

growth of the pastures in April and May this year will be especially welcome as a means of keeping the stock in good condition to face the severe late-winter spell that usually occurs.

Another important advantage of autumn top-dressing lies in the fact that while it stimulates growth in early spring practically to the same extent as would a similar amount of spring top-dressing, it is declining in the intensity of its influence by the time summer arrives, and so does not bring about such a rush of early summer growth as does spring top-dressing—a rush of growth which at times is so difficult to control effectively as to become an impediment to economical grass-farming.

Autumn top-dressing with phosphates may be summed up as the most important measure available for obviating the winter and early spring shortage of feed, which at the time of writing threatens so many, and which if not removed to a satisfactory extent will beget serious consequences in the next producing season.

In cases in which it proves impossible to completely top-dress farms in the autumn two classes of pasture should be singled out for priority in attention. Firstly, the better-class pastures, such as those containing a relatively large amount of rye-grass, should be dressed prior to inferior ones. The former, as a rule, have capacity for greater absolute response to top-dressing. This is suggested by the fact that a 20-per-cent. increase in growth of a good pasture has greater value than a 20-per-cent. increase of a relatively poor pasture. Secondly, young pastures should as a rule be given priority in a restricted top-dressing programme to older and possibly worn ones. This view is based on the belief that it is more economical to take proper care of the young pastures, and thereby to maintain them at the best possible standard, than later to have to face the difficult and costly task of repairing or renewing them.

Emergency Catch-cropping.

While top-dressing is the major matter in regard to which one should be careful not to allow false economy to replace true economy it may well be kept in mind, during current circumstances especially, that the work of growing special forage crops is one in respect to which the avoidance of expenditure may be unwise. Fortunately there is available a range of suitable forage crops which, sown in the late summer or early autumn, become available when during this year, and frequently in other years also, they may be critically needed.

Land having grown such crops as oats, wheat, maize, millet, soft turnips, or rape, may be ploughed immediately these crops are removed, and then sown without delay in temporary pasture, oats, or barley in the way described in these notes last month. If the land to be sown in such crops is so hard as to make satisfactory skim-ploughing impracticable, then cultivation with disks set with plenty of cut will frequently serve as a satisfactory alternative to the skim-ploughing. Such crops, and particularly the temporary pasture, should be sown with as little delay as possible.

In preparing the land for catch-crops it is not necessary to reduce the surface layer of soil to a fine condition. Indeed, the presence of small clods at times proves a distinct advantage. The clods prevent the caking of the surface which at times takes place in a fine surface layer of soil under beating rains, and eventually they are broken up by natural weathering. To stimulate rapid vigorous growth the forage crops mentioned above should be sown with liberal dressings of fertilizers in which superphosphate is prominent.

Utilization of Summer Feed.

Those who have practised ensilage are usually in a better position to face the critical late summer period than are those who have not. In the

first place, fields from which silage was saved at a suitably early date are likely to provide a substantial aftermath of green feed, which will prove particularly valuable, as in its characters it meets the specific needs of the season. In the second place, if necessary, silage saved during the current summer may be fed at this stage. Some who look upon their silage as a reserve of winter feed may be reluctant to feed it in the summer, but if the supply of summer feed is definitely inadequate the feeding in summer of silage intended for winter is normally well justified, particularly if it is from leafy growth. Under such conditions it will give handsome immediate returns, and there is always the possibility that it will not be so acutely needed in the winter, for even if the autumn is not particularly favourable, one may, between now and winter, have recourse to cropping here mentioned.

At times one sees maize and millet grown as green-feed crops kept too late. Frequently, rather than take the risk of having them become too woody or of having them cut down by frost, it is advisable to utilize them earlier and to employ the land thereby rendered vacant by growing one of the catch-crops mentioned. Any portion of maize or millet that cannot suitably be used as green feed should be conserved as silage, unless the amount available is so small as to make this course not worth while because of the high proportion of wastage accompanying a small lot of silage. When the amount available does not justify ensilage then it may be made into hay, and in doing this it is well to remember that it is usually somewhat difficult to dry to a safe condition the comparatively coarse stalks of these crops.

Lucerne Culture.

During March a cut of hay or green feed is commonly available from lucerne fields. After such a cut, if weeds are a menace, and dry conditions prevail it is likely to be advantageous to run over the crop with tine harrows, or other harrows fitted with teeth possessing the fine points necessary to avoid undue injury to the lucerne plants. Pertinent to this matter is the fact that more harm than good has at times been done to lucerne crops by inappropriate surface-cultivation. Cultivation may be considered unsuitable if because of its severity, or of the nature of the implements employed, it destroys an appreciable number of the lucerne plants. Hence the use of flat-toothed cultivators which cut the stems or main roots of the lucerne, proves inadvisable. If much cultivation is needed to rid lucerne of invading plants of grasses and clovers, then it may be sound practice to use the lucerne chiefly as a grazing area from which probably it will be possible to obtain not more than three cuts a year; the total value of the grazing and these three cuts is likely to be greater than that of the yield of the thin crop of lucerne alone, and, further, the cost of cultivation is not incurred.

The Pastures.

Pasture establishment is another matter in respect to which some may be led into a course involving grievous false economy—grievous because if, on the score of outlay, a weakness is allowed to creep into a permanent pasture at its establishment, the annual influence of this weakness will be multiplied according to the life of the pasture. One of the matters that allows of a reduction of outlay, which, however, is linked with a much greater reduction in eventual efficiency, is the purchase of rye-grass seed. Commercial perennial rye-grass may broadly be divided into two classes—false perennial, much of which is on the market, and true perennial, which is on the market in limited quantities and at a much higher price. Field experience demonstrates that even at the higher prices it is real and substantial economy to use the true perennial type in the establishment of permanent pastures.

It is impossible by eye examination to discriminate with any assurance between seeds of the true and of the false perennial classes of rye-grass. But fortunately the careful purchaser is not without reliable guidance in the matter. He may use certified seed, which is sold in officially sealed sacks and which to the best knowledge of the Department of Agriculture consists of true perennial rye-grass. Purchase of certified seed forms the best available guarantee that true perennial rye-grass is being secured. Farmers unable to secure certified seed may with distinct advantage to themselves have samples of rye-grass lines which they contemplate purchasing submitted to the ultro-violet ray test by this Department. This test, which is carried out free of charge for farmers, enables good rye-grass to be distinguished, with accuracy sufficient for farmers' purposes, from inferior rye-grass.

At times farmers may be inclined to lower their outlay on pasture seed mixtures by reducing the amount of cocksfoot used. As a rule this is most undesirable. Frequently in the past the amount of cocksfoot used for permanent pasture has been too small. Almost universally in New Zealand—including land on which one should aim to build up a rye-grass and white clover dominant sward—cocksfoot is of outstanding value from December onwards in providing feed during the summer period in which rye-grass and other useful pasture species are making but scant growth. At times the tufty habit of cocksfoot has been accentuated by the small number of plants in the sward due to the use of less seed than could have been advantageously used. Generally the minimum amount of cocksfoot that should be used is 10 lb. an acre, and the amount rises to 15 lb. for conditions more suited to cocksfoot than to rye-grass—for example, dry conditions of the east coast of both Islands, apart from areas where rye-grass seed production may be a major consideration.

In the interests of true economy the purity and particularly the germination of all pasture seeds, including certified lines, should be ascertained. New Zealand cocksfoot and New Zealand white clover seed almost invariably give pasture plants markedly superior to those from imported seed. The matter of pasture seed mixtures was dealt with in some detail in these notes in August, 1931, and in February, 1931.

Topping of pastures as described in last month's notes may be advisable in March. As grass harrowing during a dry spell is seldom advisable, it will be good practice on many farms as soon as March rains occur to push ahead with harrowing, in order to distribute the droppings which have been allowed to accumulate during the dry conditions.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Spraying Operations.

In those districts where hatchings of codlin moth continue well into March it may be necessary to again apply an arsenate spray to all varieties that are as yet unpicked. The control of red mite should on no account be delayed, otherwise winter egg-laying will commence, thus making the task infinitely greater.

Cultivation, Irrigation, and Cover-cropping.

In many of the fruitgrowing areas March is a favourite month for sowing the orchard cover-crop. A good seed-bed is essential, and in most soils the working into the ground of a light dressing—say, 2 cwt. per acre—of super a little while prior to sowing will materially assist the crop. In dry areas, where water is available, much can be done in the autumn to prevent the spring die-back common in those localities, by judicious

irrigation to keep the soil in an evenly moist condition. In such areas the winters are dry, and the tree-roots if left dry in the autumn will remain so until the irrigation the following spring.

Faults to avoid in handling Export Fruit.

When a crop of high-grade fruit has been produced every effort should be made to place it either on the local or the overseas market in first-class order. Although speed is essential, it should not be the governing factor in any operation in orchard or packing-shed. With the experience now gained by the older growers and the assistance rendered by the Orchard Instructors to the less experienced, there should be little trouble in gauging the maturity at which to pick the fruit. Quite a lot of fruit has to be culled out and rejected through faulty work in the orchard. Inexperienced and rough pickers should be very closely supervised. A pulled out stalk, a finger-nail mark, stalk punctures caused when pouring the fruit into the cases, bruises by dropping fruit into the picking bag, bucket, or case, the exposed point of a nail or a projecting splinter of wood in the orchard boxes, warped timber in such boxes, and the overfilling of picking utensils and cases—all these help to swell the heap of fruit which is unfit to be marketed.

On no account should fruit be allowed to remain in the sun after being picked, and every effort should be made to cool down the fruit before packing. If the wagon or truck is too high, or too highly loaded, the cases of unpacked fruit cannot be handled with ease, and bruising often results. On the other hand, too low a conveyance is liable to make the fruit dusty. In the cartage of the fruit out of the orchard, which should be done in a well-sprung vehicle, some bruising can be avoided by filling up holes here and there and rough levelling of the surface over which the conveyance has to travel.

Where it is possible to allow the fruit to stand a day or so after picking before grading and packing the skin will harden considerably, and much surface-marking will be avoided. The Sturmer in particular is benefited by this treatment, as when newly picked it is liable to show every finger mark.

In the packing-shed there should be nothing but what is required for the business in hand. It should be laid out to give the maximum light, efficiency, and space for easy working. The handling here requires the same extreme care; the grader needs to be kept in good running-order, and frequently cleaned to get rid of the oily matter which, in combination with dust and other deposits from the spray on the fruit, sets into hard lumps. Overfilled bins are often a source of bruising and stalk puncture.

In packing, efficiency must not be subordinated to record breaking; the learner especially should learn to pack properly and to eliminate every superfluous movement before endeavouring to speed up. Pressure with the hands at the ends of the cases as the fruit is being packed, and the turning of the fruit in the right direction on the top layer, will help considerably to avoid injury when lidding. The cases must be well filled with a reasonably large bulge. The nailing-down man should remember that much depends on him in avoiding case-marks and bruising when placing on the lid and when nailing down. A badly driven nail often means trouble; if projecting inward a punctured fruit will often result; if outward probably someone's ripped hand and a dropped case.

Fault can at times be found even in the labelling. If a poor paste is used the case may reach its destination minus a label. Again, the stamping of the particulars on the labels often leaves much to be desired, and when such cases reach the overseas brokers' stores the marking is

hardly decipherable, being either faded out or blurred. In both these instances the identification marks of grower, variety, size, &c., have gone, and the grower wonders why his returns are short.

These are some of the "little" matters which influence the amount of cull fruit in an orchard, and which if given proper attention will go a long way towards keeping up the high reputation we have gained for our fruit.

Miscellaneous.

In Southern districts budding should be completed as soon as possible. Where frosts are not anticipated, and the stocks are still in good condition for working, the work may be carried out during March. Stocks already budded should be watched, and when the buds have "taken" the knife should be run through the tie on the opposite side of the stock to the buds, leaving it to be gradually pushed off.

In picking for local market as well as for export it is very unwise to be short-handed and allow the picking to get behind. If the work gets ahead of the grower and there is danger of his running one variety late all the time, it is often better to cut out temporarily a variety and get on to the next, so as to keep abreast of them as they mature.

—W. R. Lloyd Williams, Orchard Instructor, Alexandra.

Citrus Culture.

The continued dry weather being experienced is having a retarding effect upon the development of the trees, and very little can be done to assist them. However, it will be wise to carry out some cultural operations during the coming period. This will break the surface, which will more readily retain the showers that may fall. Dry weather, if prolonged, places an undue strain upon the trees at a time when the young fruit is developing, and every assistance should be given them to help withstand this strain.

Care should be taken, however, to prevent an undue amount of wood growth during the autumn, as it is in the winter following that a great deal of damage to immature shoots may occur. Any fertilizers that may be applied should not be of a highly nitrogenous nature, but consist mainly of phosphates and potash. An application of a slow-acting nitrate, such as blood and bone, would not force the wood growth and could be used with safety.

If trees have been making strong growth the pinching of shoots should not be neglected. Moreover, all old and worn-out portions of branches should be removed.

There will not be a great deal of picking to be done at this period of the year, but all lemons which have reached a good marketable size should be gathered, irrespective of whether they are yellow, silver, or green. No advantage is gained by leaving them on the trees, as the next season's crop is now being developed, and everything that will place undue strain upon the trees should be avoided.

If thrips are in evidence the trees should be sprayed with Black Leaf 40 at 1–800. This can be added to the bordeaux mixture when spraying for the control of verrucosis.

L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Culling the Flock.

EVEN under the normal conditions that existed a few years ago heavy culling had to be resorted to if really payable results were to be secured from the poultry business; but at the present time it is obvious that drastic culling is imperative if a reasonable profit is to be secured over

the cost of production. The coming month is the best period of the year in which to detect the weak hens and to choose the birds which will prove profitable for another season, also to select the birds for the breeding-pen—just before the hens show signs of taking a rest prior to moulting.

Ability to judge on form at this stage will prove a valuable asset, for by possessing the necessary keenness of eye to pick out the birds not constructed on egg-producing lines a poultry-keeper is in a position to weed out the drones, reduce the food bill, and thereby increase the profit from the payable layers. To those who do not possess a trained eye for laying-form the culling of the poor layers, even at this period of the year, may prove a matter of great difficulty.

The time of moulting gives a good indication of productive capacity. All things being equal as regards the time of hatching, feeding, and general management, it is usually the poorly constituted bird which goes into an early moult, and there is no place for the early moulter when poultry are being kept for profit. It is a good rule, therefore, to eliminate the early moulters, and this point cannot be emphasized too much. Drastic culling should take place of all birds that are on the point of terminating their second laying-season; in fact, no hen of this age should be retained on the plant unless it is such a creditable member of a laying strain, and of such undoubted constitution, that it will pay to retain it for breeding purposes.

Many of the second-season layers will probably carry their old feathers right into April, and this fact will indicate even to the inexperienced eye that they will go on laying. Obviously such birds should not be culled until they give indications of taking a rest prior to moulting. Apart from early moulting as indicating the conclusion of the individual fowl's normal laying-period, the following points may be mentioned. Being overfat or above the normal weight of the breed are indications of weak constitution, as are also dull eyes, feathered face, sluggish appearance, and shrunken abdomen development to the extent that the point of the breast-bone comes in close contact with the pelvic bones, which also contract, in contrast to the bird which is in a condition to continue producing. The apparent shrinkage of the comb, with consequent disappearance of the bloom, is another sign that the bird is about to discontinue laying.

Not only should the second-season layers be heavily culled, but birds which are terminating their first laying-season should also be carefully gone through and any weak specimens eliminated. In the case of the first-year layers the culling may be light, but it should be remembered that it is unwise to retain any bird on the plant, quite irrespective of its age, which does not promise to return a good net profit.

In the work of culling it is important that the different ages of the birds be taken into consideration, particularly when the time of moulting is taken as the chief guide to productive capacity. For example, the first-season layers will usually moult before the second-season birds, especially if the latter were selected as late moulters at the conclusion of the first laying season. This indicates the necessity for having a distinguishing mark on all birds for age determination. Another matter which should be taken into account is that a sudden change of food, the supplying of inferior food, or failure to provide the food necessary for heavy egg-production, may suddenly force even a good layer into a premature moult. In such circumstances as referred to in the two latter cases, the early-moulting rule is of little value, especially to the ordinary poultry-keeper. I would emphasize the point that if none but payable stock are to be retained on the plant for future laying and breeding purposes, it is of vital importance that the best specimens should be selected and the drones

got rid of before the general moult sets in; the signs which indicate high or low laying-power do not manifest themselves after the moult has fully set in. Another advantage in culling the drones before the change of plumage takes place is that they can be marketed to better advantage. From a poulterer's point of view the bird in moult is difficult to dress and does not present an attractive appearance.

It would be a mistake to cull at the present time birds of any age that show signs of being in a laying condition. These signs consist in the bird having no indication of moulting, and possessing red combs and a fullness of the abdomen, which is soft to the touch, and which has an active business-like appearance. Such birds can be culled when they show indications of casting their feathers.

In regard to the management of the birds which are to be retained, some discretion must be exercised. The best of the late moulters which it is desired to retain for the breeding-pens next season should be kept by themselves, and an endeavour made to check their production by providing a light diet in which forcing food such as meat is eliminated. It is a mistake to force the selected prospective breeding-birds to the limit for high egg-production, as the heavy drain which this entails on the system will make a bird unfit to produce eggs with the strong germs so essential for getting stock of good constitution.

From now onwards those birds that are retaining their laying condition, and which it is intended to cull, should be given a heavy meat diet in order to secure every possible egg from them before they are disposed of. Through being subjected to highly forcing conditions it is possible that an old bird may become affected with ovarian disorders, such as protrusion of the oviduct, but trouble in this connection will be reduced to a minimum if the great bulk of the meat ration is fed separately and not included in the mash mixture.

In selecting breeding-specimens first consideration should be given to points which indicate the possession of constitutional vigour. It should always be remembered that the best layers and late moulters are not necessarily the best breeders, although it is true that the best breeder is always a late moulter. Something more is required. What should be aimed at is good size of body, laying type, and a type in which indications of utility and breed characteristics are blended with constitutional points. Regarding desired size, I may say that it is not the diminutive layer that is recommended, however well she may have laid, nor the exaggerated type evolved for the fancy show-pen, but the medium, modified type in which egg-producing power has been developed with little harm to breed characteristics and standard weight requirement. Such birds may not lay as many eggs as the smaller type, but usually they can be depended upon to produce larger eggs and to possess the necessary breeding qualifications for the maintenance of desirable characteristics in a strain over a period of years. Furthermore, both they and their progeny will return better prices when disposed of for table purposes.

No effort should be spared in securing the best possible specimens for future breeding purposes. Just as there is a type of bird specially suitable for table purposes, and which converts the bulk of its food into flesh, so also is there a type indicating by its appearance the power to convert food into heavy egg-production, as well as the power to reproduce progeny with desired laying-capacity. There are, of course, exceptions to every rule, and it does sometimes happen that a bird not conforming to a desired laying type will be a heavy producer, but it is rare that such stock can be depended upon for the building-up or for the maintenance of a uniform laying flock.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Requeening of Colonies.

ATTENTION must be given in the autumn to replacing queens which are found to cease breeding early in colonies in normal conditions with ample food. In all probability they are too old or have been injured in some way. In any case they require to be superseded as soon as possible by young queens. It is a good plan to rear as many queens as possible and have them cared for in nucleus colonies later to be introduced to full colonies where needed. It is in the spring that young queens reared in the autumn prove so valuable. Their laying-powers are at their best, consequently the colonies build up rapidly; moreover, there is less tendency for the bees to swarm.

Autumn Feeding.

In some districts after the main honey-flow is over a fair amount of nectar is gathered, sufficient to keep the bees breeding and for them to store a little surplus. However, where weather conditions are not favourable the colonies' needs may require to be supplemented in order to promote late breeding. Too often beekeepers are tempted to extract too close when making the final extraction; consequently the sudden curtailment in the food-supply checks breeding, and the colony goes into winter weak in young bees. The amount of stores in the hives is of paramount importance, and the first thought of the beekeeper in the autumn should be that of food-supply. There should be at least 30 lb. to 40 lb. of honey in each hive; and where there is this quantity or more and it appears to be diminishing rapidly the colonies should be additionally fed. It must be remembered that it is in the autumn that the beekeeper lays the foundation for his next season's crop; consequently he must concentrate on wintering his bees in the best condition possible.

Precautions against Robbing.

During the next month or so, with very little or no honey-flow, bees are likely to rob the weaker hives. Do not encourage this by exposing honey, combs, syrup, &c. Contract the entrance of the weaker hives, as this gives the inmates a better chance to protect themselves. All operations with the hives should be performed expeditiously, and if feeding is necessary carry out this operation late in the afternoon, and then with every precaution to keep the bees quiet. If robbing should start, all operations in the apiary had better cease. Contract the entrances to the hives being robbed, and throw wet grass or weeds loosely on the alighting-boards so as to prevent the entrance of the robbers. If robbing cannot be checked in this way it may be advisable to shift the affected colonies to another situation in the apiary.

Uniting Weak Colonies.

It is well to make a note of any weak colonies and any that are not doing well, as these are likely to succumb during the winter and early spring. It is by far the better plan to unite them with others rather than winter them, as they frequently become a prey to robbers, and are in that case a danger. A simple method of uniting may be practised by placing the weaker hive on top of a stronger one and placing a sheet of newspaper between the two hive-bodies. In the course of a few days the bees in the weaker hive will eat their way through the paper and unite peaceably with the bees in the stronger colony.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Club-root Control.

THE club-root fungus, *Plasmodiophora brassicae*, is frequently the cause of serious loss among garden crops of cabbage, turnips, and others of a similar kind. The roots become distorted, their functions disturbed, and the plants are starved. The fungus attacking the crop may originally be in the ground, or the trouble may be caused by setting out infected plants. It is most serious when the ground is inclined to be wet and acid, as these conditions favour the growth of the organism.

The remedy recommended to combat this serious disease has been to attend to drainage and make a liberal application of lime, but while improvement has been obtained in this way the results were frequently far from satisfactory. It is a matter of great congratulation that the Mycological Laboratory of the Plant Research Station, at Palmerston North, has carried out experiments and demonstrated that by attention to detail this remedy may be most efficient. The summary of the evidence and conclusions contained in the January number of the *Journal* demand careful study by market-gardeners and those growing vegetable crops, as what has proved a remedy for this trouble in field crops of rape and turnips can be applied with equal advantage to other crops of the kind. The experiments draw attention to the importance of the kind and quantity of lime used, the method and time of application, and the danger of destroying the good effects of the lime by drilling in the seed with a manure that is to any extent acid.

The trials prove that an amount equivalent to 1 oz. per square yard of burnt lime, freshly air-slaked, is most effective; but it must be applied some time before sowing or planting, so that it may have time to complete its work. This interval should be at least three months, and preferably twelve months; and it is important that the lime should be intimately mixed through the upper layers of the soil in which the roots grow. Finely ground carbonate of lime may be used at double the above rate stated, but it is somewhat less satisfactory. Smaller doses of burnt lime are sometimes effective, even so small as ½ oz. to the square yard, when properly applied and given time to act, but this appears to be a minimum dose.

The effect of applying freshly air-slaked burnt lime to the soil in an intimate manner is to counteract acidity, and is the natural and peculiar action of an alkaline or basic substance. Obviously this action would be discounted by drilling an acid manure with the seed; for this reason superphosphate and even basic super, as well as many special mixtures, should not be used when this disease is present. The experiments demonstrate that the manure used should be of a strongly basic nature, such as basic slag or a mixture of equal weights of superphosphate and freshly slaked lime.

Vegetable Crops.

The onion crops demand consideration at this season. During the coming spring and summer these bulbs are scarce, unless obtained from overseas, and such types are unsuitable for use in salads. Mild white onions, so useful for this purpose, are not good keepers, but, by sowing them during the month of March and planting out in early spring, a good supply may be obtained when they are in demand, there being usually a considerable shortage at that time. They should be sown thinly on soil that is moderately rich, so that growth may be steady.

The main crop of keeping onions so largely grown in Canterbury is sown in spring in that comparatively dry locality, where there is little danger of fungus disease and good weather for harvesting in late autumn can generally be relied on. In milder and moister localities the danger from disease is greater, and the prospects of good harvest weather at that period

are not so good. For these reasons it is customary in the latter localities to sow the crop during the month of March for planting out in spring. This results in the bulbs being in a forward condition before the period when disease is more troublesome, and allows of early maturity during more favourable weather

Onion crops recently harvested should have the roots and tops well dried off and then be stored in such a manner that they will not heat. The small bags of open texture and slatted boxes used by shippers are interesting methods of doing this, also the old method of weaving bulbs on strings. But almost any method which admits air freely to all parts of the stack is suitable. The store must be clean and airy, dry and damp-proof, to secure the best results. Such conditions are also suited for the storage of ripe pumpkins that are so useful during winter and early spring.

Other hardy vegetables sown now for spring planting and cropping are cabbage, cauliflower, lettuce, and spinach. These crops are most popular in the milder districts. The tender type of lettuce grown is rather subject to fungus diseases during the winter, when the seedings are much exposed to cold wet conditions. Under such circumstances they are sometimes given the protection of a cold frame and sashlights, and the warm close atmosphere which is then often developed is about as injurious as the opposite extreme. Such crops under glass should be given plenty of air and grown as hardy as possible. When water is necessary it should be given in the morning of a warm day so that the foliage may be dry before evening.

On a moist soil rich in humus the popular celery crop is grown with least trouble. Its quality and appearance depend on the sticks being clean and well blanched. Where a variety of the excellent golden self-blanching type is grown this is a comparatively easy matter, even when six or eight rows are grown close together. These and other types may be blanched by placing boards of sufficient width on edge down beside each row or multiple row. In fact, any method which excludes the light, without pressing so closely as to interfere with the growth is effective. In dealing with very large areas the rows may be carefully moulded with soil from the alleys. This treatment is best given when the usual growth is almost completed. Trimming, water, liquid manure, or any other necessary attention should be given just before moulding up for blanching, which may take from three to six weeks to accomplish.

Shorthorn carrots, turnips, and other seedling crops sown last month will require prompt attention with the hoe in fine weather in order to prevent the competition of weeds.

A soil may be richly stored with plant-foods that are not available. There is nothing so important generally for making them available as humus—material formed by the decomposition of animal and vegetable matter. Apart from any good material it may contain, its action on the physical condition of the soil is indispensable to fertility. For this reason as soon as a plot is released from cropping it should be sown down in a green cover-crop, unless it is required immediately for another purpose. Economy demands that a cover crop at this season should be quick-growing and hardy. Among those of that class generally sown are oats, barley, vetches, horse-beans, or white mustard. When these crops commence to flower it may be taken as an indication that growth is about completed, and they should be turned under, as any delay will be not only a loss of time but of quality in the material.

Rhubarb is another crop which thrives in a soil where humus is abundant. Where this crop is to be planted the land should be trenched or subsoiled in the autumn and well stocked with this material. If a small dressing of superphosphate is then given, before planting in the spring, the result should be satisfactory.

Tomato Crops: Under Glass and Outside.

The tomato crop under glass will in most instances have been harvested, and the busy grower generally will be giving attention to other crops. The glasshouses will be neglected, the old vines wither on their supports, the land will dry out, and plant insects and fungus diseases will have an excellent opportunity of becoming thoroughly established. This would not so much matter if a good rotation of cropping could be arranged, but where it is customary to grow tomatoes year after year in the same house great cleanliness is necessary, or pests and diseases get a stronger hold each year. It is therefore necessary, for many reasons, to take immediate steps to carefully remove and burn the old tomato-vines and thoroughly clean the house by spraying or fumigation, as may be necessary. When that is done light cultivation should be given, and the land sown down in a cover-crop. This crop is generally of a hardy nature, and thrives best at this season with ample ventilation at all times.

The outside crop is now being harvested. The boxes should be well filled with fruit of even maturity. This may be done economically by clean picking at regular intervals. Great interest is now being taken in the preservation of juices and pulp, and the improvements being made in the methods may be expected to increase the demand for ripe fruit at the peak of the harvest when there has often been so much waste. By preserving the fruit and juice at lower temperatures the flavour, aroma, and other qualities are retained, which increase its value and will undoubtedly make it more popular.

When selecting plants for seed more attention should be given to constitution and cropping-capacity. Too much attention cannot be given in making this selection, and the seed from each plant should be kept separate so that the type eventually will be as uniform as possible.

Berry Fruits.

Where new plantations are to be made it is well to remember that the success of the crop depends very much on how this is done. The fibrous roots of these plants lie very close to the surface, and only shallow cultivation can be done when once they are established. For this reason the subsoil should generally be well broken up and fertility deepened by turning in plenty of humus. Specially important is it that all twitches and bad weeds should be entirely eradicated; to plant out on land where there is any doubt in this respect is definitely unwise and should not be done. In such a case the land should be devoted to annual crops, which will allow the cleaning process to continue.

Where well-cured farm manure is not available in sufficient quantities, established plantations of bush fruits should be sown down now with a good cover-crop that may be turned in early and so maintain the supply of humus. This is most important where the land is light and such materials are rapidly consumed. It is generally advisable to make an application of phosphatic manures before sowing this crop. It should not be necessary to state that these operations must only be done when the land is dry and friable, but there are many who repeatedly break this important rule in agriculture; where the land is heavy the result of such a breach is deplorable.

The Homestead Garden.

Bright colours in the home garden are very arresting, but not less pleasing to many are the plants of curious and uncommon form that are so useful when interspersed among either a shrubbery which may appear a little dull or a bright patch of bloom that may be otherwise monotonous. In either case they give remarkable character to the picture, and for that reason are very valuable and demand the careful consideration of those who are planning to plant.

Among our native plants we have many very suitable for this purpose. So long as the land is of fairly good quality no position is too exposed for the cabbage-tree, tikauka, to flourish—even in localities somewhat dry. Of course, some can see no beauty in common things, especially when they are abused as this plant is so often; but the garden artist who places the cabbage-tree or a group or row of them in the picture with careful consideration will reveal great beauty in this tree lily with fragrant flowers.

In the same class, but more particular regarding environment, are the tree-ferns and nikau palms, which demand shelter from winds, and ground that is always moist. Localities with a rainfall of 36 in. per annum and upwards can usually provide this; there they may be used with confidence, and, if they are skilfully placed, with great effect. The black tree-fern, mamaku, *Cyathea medullaris*, is the favourite, but the silver species, *C. dealbata*, does well where more shade is available. In the colder districts the hard tree-ferns, *Dicksonias*, should be planted. These are unsuitable for planting in new gardens, but may be placed in position when shelter is established. Many of the older gardens could be improved by such additions.

Among shrubs and trees of this class there is the very hardy puheritaiko, *Senecio rotundifolius*, and the more tender pukanui, *Meryta Sinclarii*, with very large leaves. The lancewood, horoeka, *Pseudopanax crassifolium*, with its well known unique character; and for the North and warmer districts in the South the puriri, *Vitex lucens*, with its highly embossed leaves and cherry-like fruit.

Beside the water, our flax varieties, harakeke, should have a place, and toetoe, *Arundo conspicua*, which raises its plumes in midsummer. There are small ferns for every spot that is shaded and sheltered; and many homesteads in high country are ideally situated for growing our native alpine herbaceous plants. Planted with a suitable selection from this and other lists recently published the homestead gardens will be not merely beautiful and comfortable, but of great interest, and they will effectually preserve what has often been called the incomparable flora of New Zealand.

—W. C. Hyde, Horticulturist, Wellington.

REVIEW.

Wool Quality: A study of the Influence of Various Contributing Factors, their Significance and the Technique of their Measurement. By S. G. Barker, Ph.D., Director of Research, Wool Industries Research Association. H.M. Stationery Office, London, 1931. Price 21s.

A GRANT from the Empire Marketing Board has made it possible for members of the staff of the Wool Industries Research Association in Britain to carry out a considerable amount of work in order that a more definite meaning might be given to the word "quality" relative to wool. The past and present rather haphazard use of this word in the wool trade is cogently summed up in the first paragraph of the book under review in the following words: "The exact definition of the term 'quality' as applied to wool has proved to be an enigma which has defied precise solution from time immemorial."

The book is confined in the main to a study of those aspects of quality which affect the wool-sorter's estimation of the spinning properties of a wool, and a highly technical subject has been so treated that it makes attractive reading for those who are deeply interested in the subject. The

author has attempted to summarize not only the results of the work of his co-workers, but also that of most other workers whose endeavour it is to measure the various attributes of wool and to improve its manufacturing performance. Therefore, a good deal of the material in the book is not new, but has been summarized and brought together under one cover.

The subject-matter is well arranged in general so as to give a continuity to the reading, but since reference is made to wool-sorting in the first section dealing with wool-classing, the two might well have been grouped together rather than separated by a fairly large section dealing with wool-grease. This latter section deals fully with the importance of the grease, both to the fleece and to the manufacturer.

The most important section in the book is probably that dealing with the techniques used for measuring the various attributes of the wool fibre, and the history of these methods. Particular reference is made to the work carried out in the Research Association's laboratories, which has shown that there is a definite mathematical relationship between the fibre fineness of the various qualities of wool-tops, and it is pointed out that this should form a basis for an international agreement on standards for the various grades of wool.

Further sections deal fully with other fibre characters, such as crimp, contour, length, &c., the chemical and physical constitution and the structure of the wool, and a number of defects which limit the spinning-qualities of the fibre. In this latter section reference is made to the improvement which has been made in branding-fluids, and the attempts which are being made to introduce new and better types of wool-packs. In the summary it is admitted that, although much has been learnt in recent years about the various properties of the wool fibre, there is still much to learn before a full and concise answer can be given to the question, "What is wool quality?"

With due respect to Dr. Barker and his colleagues, exception must be taken to the statement on page 270 that the defect of weak or rotten wool "appears to be confined to New Zealand." Only one of many types of weak wool is referred to—*i.e.*, that due to bacterial breakdown of the wool fibre—and to say that it is confined to New Zealand is erroneous. A similar defect was reported from Australia some time ago, and is present most likely in the clips of most wool-producing countries, though as yet not specifically identified.

The bibliography contains reference to over six hundred publications bearing on the subject, but even then it cannot be said to be exhaustive, since among other points no reference is made to Sutton's work on wool-grease, although several pages of the book are devoted to this aspect of the work.

The book is clearly printed on good paper, and is well illustrated by good photographs, drawings, figures, and tables which serve to demonstrate clearly the points made. It forms a very useful addition to the literature of wool, bringing together as it does under one cover most of the present-day technical knowledge of the subject. This is particularly valuable in the case of research workers and teachers overseas, where it is often difficult to obtain copies of articles published in other countries. The book should prove useful also to managers of woollen mills, since it deals with the effects of recent research on certain phases of manufacture. At the same time it might quite well find a place as a work of reference in the libraries of those secondary schools and colleges where wool is studied as part of an agricultural course.

D. J. S.

WEATHER RECORDS: JANUARY, 1932.

Dominion Meteorological Office.

JANUARY proved to be a less pleasant month than the preceding two. It was remarkable for the persistence of strong westerly or north-westerly winds, Auckland Province being the only portion of the country to escape them. Temperatures were low for January, December having been a warmer month at many places.

Rainfall.—In the North Island the rainfall was much below the average. In the eastern districts of the South Island, too, there was a deficit which, though at most places not large, was especially detrimental owing to dry conditions having existed for many months previously. Frequent showers were experienced in Otago, except for the extreme northern portion. On the whole of the west coast of the South Island the rains were heavy. Indeed, the complaint there was of too much rather than too little precipitation. In Nelson and Marlborough, also, there were good rains. In the greater part of the North Island the rain amounted only to about half the average. Parts of the west coast, the Bay of Plenty, and also Whangarei experienced more normal conditions. In western districts of the South Island, and most of Otago, the experience was the reverse of that in the North Island, some places receiving almost double the average fall for January. From Hanmer Springs southward to Oamaru and its back country, the total was less than the average, and much of the rain was too light to be of much benefit.

Temperatures.—Though eastern districts experienced many warm days while the north-west winds were blowing, changes were frequent and the nights were generally cool. The mean temperature was between 3° and 4° F. below the normal for January in places exposed directly to the westerly winds. East of the ranges the departures were much smaller. Frosts occurred in parts of the South Island on the 2nd, and some damage was done to tender crops. A second frost, on the 31st, was rather more severe, and extended to parts of the North Island.

Winds.—The prevalence of north-west or westerly winds has already been mentioned. In the Taranaki Bight and Wellington Province, generally, those of the 3rd and the 26th were the most severe, some damage being done. The desiccating nature of the westerly winds accentuated the effects of the drought in the eastern districts.

Storm Systems.—The weather generally was of the type characteristic of spring rather than summer. Westerly depressions moved from Australia with unusual speed and regularity. Most weeks saw the advent of two of them, the total for the month being ten. Several were deep to the southward, but their northward extensions were generally poorly developed. The second of the depressions was a complicated one, the weather remaining unsettled from the 2nd to the 5th. The greater part of the Dominion received moderate to heavy rain during this period.

On the 9th a cyclone developed on the east coast of Australia and passed to the southward of New Zealand next day. It brought heavy rains to Taranaki and the western half of the South Island.

This storm was followed during the 14th to 16th by one which, unlike the others experienced during the month, had a good northward extension. A centre developed in this northern portion, and heavy rains were recorded over practically the whole of the North Island. In the north-central portion, especially, the falls were very heavy.

The last storm of moment passed on the 28th and 29th, when rain was again widespread. The heaviest falls were in western districts.

RAINFALL FOR JANUARY, 1932, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
	North Island.	Inchers.		Inches.	Inches.
1	Kaitaia	2·03	8	0·97	4·36
2	Russell	1·94	7	0·50	3·48
3	Whangarei	4·31	8	2·02	3·84
4	Auckland	1·14	7	0·30	2·61
5	Hamilton	1·97	9	1·09	3·70
6	Rotorua	2·83	6	2·16	4·04
7	Kawhia	3·31	8	1·08	3·24
8	New Plymouth	3·45	10	1·01	4·25
9	Riversdale, Inglewood ..	5·33	12	1·38	7·36
10	Whangamomona	3·73	5	1·32	5·33
11	Eltham	2·32	7	0·75	3·47
12	Tairua	2·08	8	0·84	3·87
13	Tauranga	1·20	5	0·50	4·11
14	Maraehako Station, Opotiki	3·65	7	2·60	3·70
15	Gisborne	1·29	8	0·37	2·77
16	Taupo	2·05	6	1·41	3·36
17	Napier	0·44	7	0·27	3·02
18	Hastings	1·12	7	0·55	1·99
19	Taihape	1·33	9	0·50	3·13
20	Masterton	1·49	8	0·82	2·55
21	Patea	2·67	8	0·75	3·46
22	Wanganui	1·70	7	0·79	2·79
23	Foxton	0·94	4	0·58	2·09
24	Wellington	2·16	11	0·82	2·81
	South Island.				
25	Westport	11·52	19	3·52	8·20
26	Greymouth	9·74	18	3·78	9·27
27	Hokitika	19·59	21	5·47	9·82
28	Ross	19·66	15	4·34	11·59
29	Arthur's Pass	15·48	13	2·82	10·66
30	Okuru	19·12	19	3·03	12·26
31	Collingwood	8·64	10	1·96	6·28
32	Nelson	3·39	8	1·34	2·74
33	Spring Creek	2·26	8	0·75	2·07
35	Hanmer Springs	3·00	11	0·97	3·55
36	Highfield, Waiau	..	..	..	2·96
37	Gore Bay	1·32	8	0·40	2·41
38	Christchurch	0·86	13	0·31	2·17
39	Timaru	2·12	15	0·44	2·17
40	Lambrook Station, Fairlie ..	2·01	12	0·31	2·34
41	Benmore Station, Clearburn	2·78	15	0·67	2·66
42	Oamaru	1·77	18	0·33	2·04
43	Queenstown	4·03	16	0·78	2·75
44	Clyde	2·84	12	0·94	1·77
45	Dunedin	3·92	18	0·85	3·33
46	Wendon	2·80	14	0·50	3·15
47	Gore	..	..	..	3·08
48	Invercargill	5·84	21	0·75	3·93
49	Puysegur Point	10·64	26	1·14	7·10
50	Half-moon Bay	6·22	21	0·97	4·34

Orange-tree killed by Milk.—The Orchard Instructor, Gisborne, reports that a ten-year-old orange-tree at Patutahi died recently as a result of skim-milk having been thrown around its trunk.

PERENNIAL RYE-GRASS SEED CERTIFICATION.

LIST OF GROWERS, SEASON 1931–32.

FOLLOWING is a list of growers who have had areas of perennial rye-grass seed inspected and passed in the field, in connection with the Government system of Seed Certification, for the season 1931–32 :—

Name.	Address.	Name.	Address.
Poverty Bay.		*Poverty Bay*—ctd.	
Allen, W. ..	Matawhero.	Jones, G. ..	Waerengaahika.
Alley, A. J. M. ..	Manutuke.	Jones, T. R. ..	Ormond.
Anderson, J. ..	Waerengaahika.	Judd, A. J. ..	Patutahi.
Atkins, J. ..	Patutahi.	Judd, A.R. and C. P.	Patutahi.
Atkins, W. ..	Patutahi.	Kane, T. ..	Matawhero.
Baillie, T. ..	Waimate Valley.	Kent, H. ..	Makaraka.
Baird, W. ..	Waerengaahika.	Knight, L. A. ..	Repongaere.
Barber, W. E. ..	Hexton.	Lange, H. D. C. ..	Matawhero.
Barr, J. P. ..	Te Karaka.	Lawless, D. ..	Manutuke.
Bell, H. ..	Hexton.	Linklater, J. ..	Waerengaahika.
Black, E. R. ..	Manutuke.	Lynn, T. ..	Manutuke.
Bolitho, N. G. ..	Waerengaahika.	Miller, R. C. and H. R.	Ormond.
Boyd, J. ..	Manutuke.		
Briant, S. D. ..	Patutahi.	Mills, D. ..	Makauri.
Brown Bros. ..	Waerengaahika.	Moore, H. ..	Makaraka.
Brown, J. B. ..	Waerengaahika.	Moore, R. H. ..	Waerengaahika.
Bull, W. C. ..	Te Karaka.	Mortleman, A. ..	Makauri.
Butler, P. ..	Patutahi.	Mullan, B. P. ..	Waerengaahika.
Cameron, A. J., Estate	Waerengaahika.	McIntosh, A. ..	Patutahi.
		O'Grady, D. ..	Makauri.
Cameron, R. ..	Patutahi.	Paku, O. ..	Whakaki.
Campbell Bros. ..	Hexton.	Paulson, A. E. ..	Waerengaahika.
Candy, A. E. ..	Waerengaahika.	Peakman, W. ..	Whakaki.
Carroll, A. T. ..	Wairoa.	Pilmer, W. C. ..	Makaraka.
Carroll and Cooper	Patutahi.	Read, F. ..	Makauri.
Clark, W. ..	Opou.	Reeve, E. A. ..	Hexton.
Cooper, H. ..	Patutahi.	Roche, J. ..	Hexton.
Daulton, J. E. ..	Manutuke.	Rogers, J. J. ..	Makauri.
Davies, J. ..	Ormond.	Russell, J., Estate	R.M.D., Gisborne.
Duncan, A. ..	Waerengaahika.	Scott, Mrs. C. ..	Makauri.
Dunstan, T. J. ..	Matawhero.	Scott, G. ..	Waipaoa.
Fenton, R. G. ..	Waerengaahika.	Scott, R. ..	Puha.
Fisken, R. C. ..	Matawhero.	Sherriff, A. E. ..	Ormond.
Frazer, E. W. ..	Waerengaahika.	Smith, G. V. ..	Patutahi.
Frazer, T. ..	Whangara.	Smith, W. W. ..	Bushmere.
Gibson, C. ..	Matawhero.	Staples, W. ..	Makauri.
Gordon Bros. ..	Mangapapa.	Stevens, A. E. ..	Patutahi.
Gray, C., Estate ..	Hexton.	Stuart, F. ..	Patutahi.
Gray, S. T. ..	Hexton.	Symes, H. ..	Nuhaka.
Habgood, F. ..	Patutahi.	Taylor, J. ..	Ormond.
Hair Bros. ..	Patutahi.	Teitjen, C. ..	Waerengaahika.
Hansen, R. ..	Hexton.	Tombleson, T. W. G.	Nuhaka.
Haraki, W. ..	Whakaki.	Torrie, J. ..	Waerengaahika.
Hills, M. P. ..	Ngatapa.	Tullock, H. R. ..	Te Karaka.
Holden, T. ..	Hexton.	Turner, J. ..	Makauri.
Huka, I. ..	Whakaki.	Waiherere Incorporation	Gisborne.
Hunt, J. ..	Hexton.		
Irwin, F. A. ..	Patutahi	Whitlock, J. ..	Makauri.
Jackson, W. G. ..	Waerengaahika.	Williams, H. C. ..	Muriwai.
Jobson, W., Estate	Manutuke.	Wilson, G. ..	Bushmere.
Johnstone, J. G.	Waiherere.	Witters, G. ..	Hexton.

LIST OF GROWERS—*continued.*

Name.	Address.	Name.	Address.
Hawke's Bay.		*Hawke's Bay*—ctd.	
Agnew, J. ..	Mangateretere.	Holden, L. S. ..	Mangateretere.
Alexander, J. ..	Puketapu.	Holmes, P. C. ..	Whakatu.
Allen, A. W. ..	Tomoana.	Horner, V. T. L. ..	Waipukurau.
Allom, G. S. ..	Havelock North.	Houston, C. ..	Hastings.
Anderson, C. ..	Mangateretere.	Hunt, A. ..	Taradale.
Anderson, E. H.	Whakatu.	Joll, V. H. ..	Pakipaki.
Apperley, H. G. ..	Hastings.	Jones, H. G. ..	Mahora.
Ashworth and Gavin	Pakowhai.	Jones, H. ..	Pakowhai.
Avison, O. D. ..	Haumoana.	Kenderdine, J. A.	Otane.
Baird, A. J. ..	Raupare.	Klingender, G. W.	Meeanee.
Beatson, G. D. ..	Hastings.	Knowles, W. C. ..	Pakowhai.
Beattie, J. ..	Twyford.	Kyle, T. ..	Raureka.
Bolt, Mrs. M. K. ..	Hastings.	Lane, M. ..	Te Awanga.
Bone, C. ..	Hastings.	Langdon, W. H.	Haumoana.
Boyle, D. J. ..	Pukahu.	Lascelles, P. W. ..	Mangateretere.
Bridgman, J. ..	Mahora.	Lister, H. H. ..	Clive.
Bridgman, S. G. ..	Haumoana.	Lloyd, J. ..	Clive.
Bridgman, T. ..	Mahora.	Lloyd, J. H. ..	Mangateretere.
Burge, A. J. ..	Twyford.	Logan, J. F. ..	Waipawa.
Burge, F. ..	Twyford.	Logan, W. ..	Otane.
Burgess, T. ..	Meeanee.	Loughnan, C. A.	Otane.
Burns, H. H. ..	Twyford.	Manson, A. ..	Twyford.
Burns, W. F. M. ..	Hastings.	Mardon, H. ..	Mahora.
Byford, W. J. ..	Haumoana.	Marshall, Mrs. E. M.	Hastings.
Carlyon, — ..	Poukawa.	Masters, A. J. ..	Twyford.
Clark, H. R. ..	Waiohika.	Masters, L. ..	Twyford.
Couper, E. D. ..	Havelock North.	Merrikin, G. ..	Hatuma.
Cranko, D. ..	Mangateretere.	Morrin, T. V. ..	Hastings.
Crawford, H. ..	Havelock North.	Murphy, P. B. ..	Mahora.
Currie, D. ..	Twyford.	Murphy, Mrs. P. B.	Mahora.
Currie, T., sen. ..	Twyford.	McCool, J. ..	Mangateretere.
Donnelly, W. H. C.	Pukahu.	McCutcheon Bros.	Fernhill.
Drummond, P. ..	Puketapu.	Macdonald Bros.	Havelock North.
Elliott, D. H. ..	Haumoana.	Macdonald, J. ..	Meeanee.
Emmerson, T. ..	Raureka.	McGaffin, A. ..	Elsthorpe.
Evans, F. E. ..	Twyford.	Mackay, A. C. ..	Mahora.
Evans, H. S. ..	Pukahu.	McKeesick, H. J.	Haumoana.
Fernie, D. ..	Pakowhai.	McKeown, G. ..	Mangateretere.
Field Bros. ..	Waimarama.	McLean, A. ..	Twyford.
Field, G. C. ..	Waimarama.	McLeod, D. E. ..	Raupare.
Freeman, S. ..	Haumoana.	McLeod, D. E. ..	Fernhill.
Frogley, R. ..	Mangateretere.	McLeod, H. ..	Raupare.
Gilbertson, H. R.	Havelock North.	McLeod, W. ..	Pakipaki.
Gillies, J. ..	Tomoana.	McLernon, P. ..	Mahora.
Glazebrook, H. M.	Maraekakaho.	McNab, J. A., sen.	Twyford.
Goodrick, C. F. ..	Mangateretere.	McNab, J. A., jun.	Twyford.
Gregory, R. ..	Clive.	McRobbie, I. W.	Waimarama.
Griffiths, R. ..	Twyford.	McRobbie, J. A.	Havelock North.
Guthrie, T. ..	Clive.	Neagle, P. P. ..	Meeanee.
Haldane, C. ..	Hastings.	Nelson, E. M. ..	Mangateretere.
Hardy, G. F. ..	Pukahu.	Nicholl, P. G. ..	Twyford.
Harris, J. H. ..	Hastings.	Nimon, Mrs. E. ..	Havelock North.
Harris, L. E. ..	Clive.	O'Neill's Estate ..	Mahora.
Heard, F. T. ..	Hastings.	Orbell, A. ..	Clive.
Heeney, Mrs. M.	Mahora.	Otene, B. ..	Tomoana.
Heeney, T. P. ..	Mahora.	Otene L. ..	Tomoana.
Herbert, H. L. ..	Mahora.	Otene,, T. ..	Tomoana.
Heynes, W. ..	Clive.	Panapa, T. ..	Tomoana.
Hill, A. E. ..	Mahora.	Parsons, P. ..	Meeanee.

LIST OF GROWERS—*continued.*

Name.	Address.
Hawke's Bay—ctd.	
Person's Estate ..	Fernhill.
Pickering and Hackett	Waiohika.
Pimley, F. ..	Mahora.
Potter, Mrs. O. ..	Fernhill.
Potter, W. ..	Fernhill.
Price, Little, and Wilson	Puketapu.
Ramsay Bros. ..	Haumoana.
Rathie, J. J. ..	Clive.
Ryan, T. ..	Elsthorpe.
Satherley, F. ..	Havelock North.
Simson, I. L. ..	Tomoana.
Sinclair, A. ..	Mahora.
Skudder, A. ..	Mangateretere.
Small, C. E. ..	Hastings.
Smith, A. H. ..	Poukawa.
Smith, E. ..	Twyford.
Smith, F. R. ..	Raupare.
Speers, A. ..	Pakipaki.
Starnes, Mrs. M. A.	Haumoana.
Stead, W. G. ..	Raupare.
Stevenson, W. G.	Havelock North.
Struthers, A. ..	Longlands.
Struthers, J. ..	Pukahu.
Struthers, W. ..	Raureka.
Sweeney, L. ..	Mahora.
Symes, A. F. M.	Longlands.
Tait, T. ..	Twyford.
Tattersall, C. E. ..	Pakowai.
Taylor, H. ..	Pukahu.
Taylor, J. ..	Havelock North.
Taylor, W. ..	Havelock North.
Thompson, C. H.	Twyford.
Thompson, D. P. H.	Twyford.
Thompson, J. B. ..	Mahora.
Thompson, J. H. and G.	Mangateretere.
Thompson, T. J.	Pakowhai.
Thompson, W. P., Estate	Pakipaki.
Tiffen, D. N. ..	Otane.
Tod, R. H. ..	Otane.
Trotter, R. ..	Hastings.
Tucker, R. M. H.	Waiohika.
Tucker, W. ..	Whakatu.
Vance, Mrs. L. J.	Havelock North.
Wake, A. E. ..	Pukahu.
Wake, B. ..	Karamu.
Wall, E. ..	Mahora.
Wall, W. J. ..	Hastings.
Wattie, W. J. ..	Mahora.
Wellwood, M., Estate	Hastings.
Wellwood, R. A. ..	Mahora.
White, W. J. ..	Pakowhai.
Williams, H. B. ..	Pukahu.
Wilson, F. H. ..	Eskdale.
Young, J. A. ..	Haumoana.
Yule, D. C. ..	Mahora.

Name.	Address.
North Auckland.	
Stevens, K. M. ..	Maungatapere.
Auckland.	
Smyth, R. C. ..	Te Kauwhata.
Wanganui.	
Birch, A. C. ..	Marton.
Manawatu.	
Bailey's Estate ..	Sanson.
Buchanan, A. R.	Kairanga.
Buchanan, R. H.	Feilding.
Callesen, J. ..	Longburn.
Campbell, N. ..	Awahuri.
Fagan, H. J. ..	Sanson.
Henson, W. H. ..	Feilding.
Parsons, S. ..	Kairanga.
Perrett, J. ..	Sanson.
Reid, D. W. ..	Feilding.
Wilson, G. H. ..	Bulls.
Young, J. ..	Awahuri.
Young, W. J. ..	Kairanga.
Wairarapa.	
Percy, A. J., Estate	Masterton.
Yule, G. E. ..	Featherston.
Marlborough.	
Berryman, H. ..	Ward.
Blick, A. ..	Blenheim.
Goulter, C. P. ..	Seddon.
Moore, T. A. ..	Havelock.
Neal, J. F. ..	Seddon.
Nees, C. ..	Okaramio.
Nicolas, J. T. ..	Ward.
Smith, E. ..	Spring Creek.
North Canterbury.	
Bailey, P. V. ..	Springston.
Bishop, R. G. ..	Southbridge.
Boag, J. ..	Brookside.
Brookes, J. ..	Brookside.
Chamberlain, R.	Ellesmere.
Cross, A. E. ..	Bennetts.
Cunningham, W. B.	Brookside.
Forbes, G. W. ..	Cheviot.
Galpin, H. ..	Southbridge.
Greenwood, A. C.	Southbridge.
Grigg, G. H. ..	Horarata.
Harrison, G. H. ..	Cheviot.
Heslop, J. ..	Brookside.
Lill, D. ..	Brookside.
Marshall, D. ..	Springston.
Morgan, T. C. ..	Tai Tapu.
McGregor, D. ..	Ellesmere.
Nairn, G. ..	Lakeside.
Nutt, H. ..	Motukarara.
Powell, C. N. ..	Springston.
Russell, J. ..	Omihi.
Skurr, K. ..	Dunsandel.

LIST OF GROWERS—*continued.*

Name.	Address.
N. Canterbury—ctd.	
Smith, T. J. ..	Oxford.
Stevenson, J. ..	Flaxton.
Stevenson, J. B. ..	Spotswood.
Stevenson, T. ..	Spotswood.
Thwaites, W. ..	Hororata.
Walker, J. ..	Dunsandel.
Williams, C. M. ..	Kaiapoi.
Wyllie Estate ..	Southbridge.
Mid-Canterbury.	
Doak, A. ..	Barrhill.
Jones, C. H. ..	Winchmore.
McDonald Bros. ..	Methven.
MacKay, T., Estate	Willowby.
Nicoll, E. F. ..	Ashburton.
Rutherford, T. ..	Springburn.
Tilson, W. R. ..	Hinds.
Wilkinson, H. R.	Chertsey.
South Canterbury.	
Anderson, J. ..	St. Andrew's.
Brodie, R. ..	Rangitata.
Campbell, R. and P.	Kingsdown.
Gardiner Bros. ..	Temuka.
Hammond, R. ..	Fairview.
Hide, T. E. ..	Seadown.
Medlicott, S. ..	Waimate.
Mee, J. P. D. ..	Levels.
Milne, J. H. ..	Waimate.
McKenzie, H. ..	Waimate.
O'Hara, J. C. ..	Glenavy.
Oliver, J. O. J. ..	Temuka.
Stewart, J. ..	Morven.
Talbot, P. R. ..	Claremont.
Central Otago.	
Hunt, J. S. ..	Maungawera.
Otago.	
Blackie, W. ..	Glenoamaru.
Bradfield, W. ..	Owaka.
Bunn, Mrs. A. E.	Rongahere.
Chittock, C. ..	Waikoikoi.
Coulbrough, D. ..	Kelso.
Falconer, D. A. ..	Kelso.
Findlayson, P. ..	Crookston.
Hayman, E. W. ..	Tuapeka Mouth.

Name.	Address.
Otago—continued.	
Jenkins, D. ..	Kelso.
Jones, J. ..	Clifton.
Murney, E. H. ..	Tapanui.
McRae, J. D. ..	Waitahuna.
Pullar, J. G. ..	Crookston.
Sim, S. ..	Heriot.
Sutherland, W. ..	Clinton.
Southland.	
Ayton, Mrs. I. B.	Otautau.
Barron, W. ..	Morton Mains.
Blue, A. ..	Balfour.
Brown, T. ..	Otautau.
Burgess, H. A. ..	Invercargill.
Carter, G. H. ..	Mandeville.
Clark, G. ..	Pyramid.
Couser, W. ..	Mataura Il.
Cowie, H. ..	Otapiri R.D.
Cowie, W. J. ..	Otapiri R.D.
Forbes, J. ..	Waimumu.
Fowler, W. ..	Winton.
Haigh, J. R. ..	Waipango.
Hardiman, P. ..	Pyramid.
Hishon, W. P. ..	Oreti.
Holmes, F. ..	Riverton.
Kelly, N. ..	North Chatton.
Morgan, T. A. ..	Limehills.
Mortimer, W., jun.	Waipounamu.
McCully, W. D. ..	Scott's Gap.
Macdonald, J. ..	Gore.
Mackay, A. ..	Wendon.
Mackay, G. ..	Glencoe.
Mackay, W. G. ..	Otawa.
Mackenzie, D. ..	Limehills.
Mackenzie, K. A.	Otapiri.
McLean, D. H. ..	Dipton.
McLeod Bros. ..	Mandeville.
McNaughton, J. ..	Wright's Bush.
McRae, M. A. ..	Wyndham.
Nicholl, N. ..	Kingston Crossing
O'Connor, J. ..	Kingston Crossing
Riddle, H. J. ..	Thornbury.
Telfer, T. ..	Brydone.
Tuach, J. ..	Croydon Bush.
Walker Bros. ..	Wendon.
White, R. S. ..	Otama.
Wilson, C. ..	South Hillend.
Winsloe, J. G. E.	Waikaka.

A supplementary list will be published in a later issue of the *Journal*, together with a table showing number of areas and acreage under each certification class.

—*Fields Division.*

Compensation paid for Stock and Meat condemned.—Compensation to the amount of £17,225 was paid out during the financial year 1930–31 for animals condemned in the field for disease under the provisions of the Stock Act, and £14,496 for carcasses or parts of carcasses condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

THE "NEW ZEALAND CURD TEST" AND MILK GRADING.

THE curd test as a method of judging the quality of milk for cheese-making has been before factory managers and milk suppliers since the writer introduced it at many meetings of suppliers in 1901. The chief shortcoming of this test hitherto has been the attention required during the day.

Recognizing that compulsory milk-grading would necessitate the use of an efficient practical test, an endeavour has been made to avoid much of the attention hitherto required by the curd test. The writer has suggested that the bottles containing the milk, and later the curd samples, should be placed in racks which can be housed in a container, the temperature of which can be controlled, as required, by the use of steam or electricity. This idea has been developed with the assistance of Messrs. G. F. V. Morgan and M. Syron of the Dairy Division. The milk samples may be warmed in this container for renneting. Imperial half-pint bottles with cardboard stoppers are used. The bottles are fixed in the rack so that they retain their place when their containing rack is revolved. A small electric motor or a small belt from the factory main shaft can be used for revolving the horizontal shaft in the container for the test-bottle racks. When the curd is ready for breaking the power revolves the rack at the rate of about twenty-five to thirty revolutions per minute. This breaks up the curd in the bottles. The temperature inside the container is raised to about 100° F., and the revolving is continued until the curds are "cooked." The cardboard disks are then discarded and the tops of the bottles are covered with gauze which is supported in its position but so that whey may escape when the bottles are inverted. The whey is drained by giving the rack half a revolution, which inverts the bottles. The curds are thus allowed to drain, the temperature of the container being maintained until the curds are ready for examination in six to seven hours from the time of adding the rennet.

The bottles may be washed in the container by using a revolving brush fixed to the container shaft. They can afterwards be sterilized in the same container and held there until required on the receiving stage for further samples.

—W. M. Singleton, Director of the Dairy Division.

AREA OF GRASSLAND TOP-DRESSED, 1930-31.

THE following table, supplied by the Census and Statistics Office, shows the area of grassland in New Zealand top-dressed during the twelve months ended 31st January, 1931. Particulars of kinds of fertilizer and quantities of fertilizer and lime applied are not available for the period under review.

Land District.	Area of Grassland Top-dressed with Artificial Fertilizers once or more during Period.	Area of Grassland Top-dressed with Lime during Period.
	Acres.	Acres.
North Auckland	408,978	54,727
Auckland	883,302	168,926
Gisborne	43,059	1,835
Hawke's Bay	123,232	9,223
Taranaki	327,914	32,862
Wellington	307,290	39,761
Nelson	26,773	6,362
Marlborough	20,376	1,847
Westland	7,349	3,504
Canterbury	93,159	40,681
Otago	62,702	23,114
Southland	128,304	56,036
Total, Dominion ..	2,432,438	438,878

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MORTALITY AMONG PIGS AFTER CASTRATION.

J. K. G., Opunake :—

For the last three years deaths among my pigs, seemingly from castration, have been about 10 per cent. The pigs swell up after cutting, pine away, and finally die. There are no symptoms before cutting. I always use kerosene freely after cutting. Kindly advise if kerosene is harmful, also as to treatment of the trouble generally.

The Live-stock Division :—

In all probability the deaths have occurred as a result of abscess-formation after castration has been carried out. Strict cleanliness of operating knives and surroundings must be attended to at the time of castration. Immediately after castration, owing to irritation at the site of operation, it is not unusual to see pigs contaminate the wound. Therefore clean surroundings are absolutely essential. A weak solution of one of the standard disinfectants is to be preferred to kerosene as an antiseptic. Young animals suffer less from the effects of castration than older animals. It is advisable to operate at an early age. Further information on the subject will be found in the Department's Bulletin No. 150, "Castration of Pigs and Calves," a copy of which has been sent to you.

SHY BEARING APRICOT-TREE.

"AMATEUR," Taradale :—

I have an apricot-tree which has only borne half a dozen or so fruit each year for about five years. Seven years ago it had a small crop, perhaps a bushel, while a smaller-variety apricot standing next to it bears a splendid crop every year. Could you suggest what is the reason of it not bearing fruit, and the treatment to be adopted? The fruit are very large and richly coloured, and the tree appears quite healthy, though it does not increase in size.

The Horticulture Division :—

The experience with your apricot-tree is similar to that in other fruitgrowing districts, with the exception of Central Otago and parts of the Coromandel Peninsula, where good crops of most varieties can be depended on, if late frosts do not occur. The outstanding characteristic of those localities is the low rainfall, which seems to suit the crop, specially at the time of setting. The small variety that crops well consistently is probably that known as Newcastle, which commonly has those generous qualities. Treatment that may be expected to encourage other varieties to bear would be to plant the trees on the sunny side of a wall and train them as espaliers—a method of production that is too expensive for commercial purposes. Possibly a variation of the pruning system would have some effect.

ARTICHOKE TOPS FOR ENSILAGE.

"BUTTERFAT," Tauranga :—

Could the young tops of Jerusalem artichokes be used for ensilage? The artichokes are self-sown and fine in the stalk; they could be mixed with Japanese millet and red clover.

The Fields Division :—

The fact that the tops of artichokes are not greatly relished by stock would indicate that the quality of ensilage made from them would probably be low. However, this should not deter you from converting them into silage, as even weeds such as Californian thistle can be utilized in this manner. With regard to

the mixing of these tops with Japanese millet and red clover, we would suggest that you ensile the artichoke tops separately (if sufficient bulk of them is available), as both millet and red clover are of superior quality for this purpose, and would consequently make better ensilage if kept apart from the tops. You may then at a later date be able to arrange your feeding-out so as to give springing and milch cows the millet and clover ensilage, while dry stock might receive the artichoke tops, or a portion of them with millet and clover ensilage.

ESTIMATED YIELDS OF WHEAT, OATS, AND BARLEY.

THE following estimated average yields per acre of wheat, oats, and barley for the season 1931–32 have been compiled by the Census and Statistics Office from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 10th February :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.	Barley. Bushels per Acre.
North Island	28·23	33·49	42·28
Nelson	19·04	21·08	18·16
Marlborough	28·18	30·73	28·07
Canterbury	23·76	26·25	27·54
Otago	25·69	33·99	29·59
Southland	35·70	44·36	34·63
Average (estimated) for the Dominion, season 1931–32	24·44	32·56	28·79
Average (actual), for the Dominion, season 1930–31	30·44	38·74	34·97

In accordance with the above estimates, the total yield of wheat for the season 1931–32 should be approximately 6,660,000 bushels, as against an actual yield of 7,579,153 bushels for the season 1930–31.

The proportion of oats threshed for the five seasons ending with 1930–31 averaged 26·57 per cent. of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 2,850,000 bushels, as against an actual yield of 3,376,609 bushels for the season 1930–31.

Assuming that the percentage of the barley area threshed remains the same as last year, the total yield of grain should be approximately 530,000 bushels, as against an actual yield of 837,696 bushels for the season 1930–31.

FERTILIZER IMPORTATIONS: DECEMBER QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 31st December, 1931 :—

Sulphate of Ammonia : United Kingdom, 1,575 tons. *Nitrate of Soda :* Chile, 670 tons. *Basic slag :* United Kingdom, 125 tons; Belgium, 430 tons. *Chardust and bonechar :* Australia, 20 tons. *Guano :* United Kingdom, 15 tons; Madagascar, 793 tons; New Caledonia, 3,600 tons. *Rock phosphate :* Ocean Island, 18,120 tons; Nauru Island, 20,986 tons; Tuamotu Archipelago, 7,376 tons. *Superphosphate :* Netherlands, 100 tons. *Phosphates (other) :* United Kingdom, 25 tons; Belgium, 100 tons. *Kainit :* France, 9 tons; Poland 50 tons *Muriate of potash :* France, 10 tons. *Sulphate of potash :* Belgium, 5 tons; France, 48 tons; Germany, 200 tons. *Potash (other) :* Belgium, 5 tons; France, 171 tons; Germany, 415 tons; Poland, 206 tons. *Sulphate of iron :* United Kingdom, 9 tons; Australia, 11 tons.